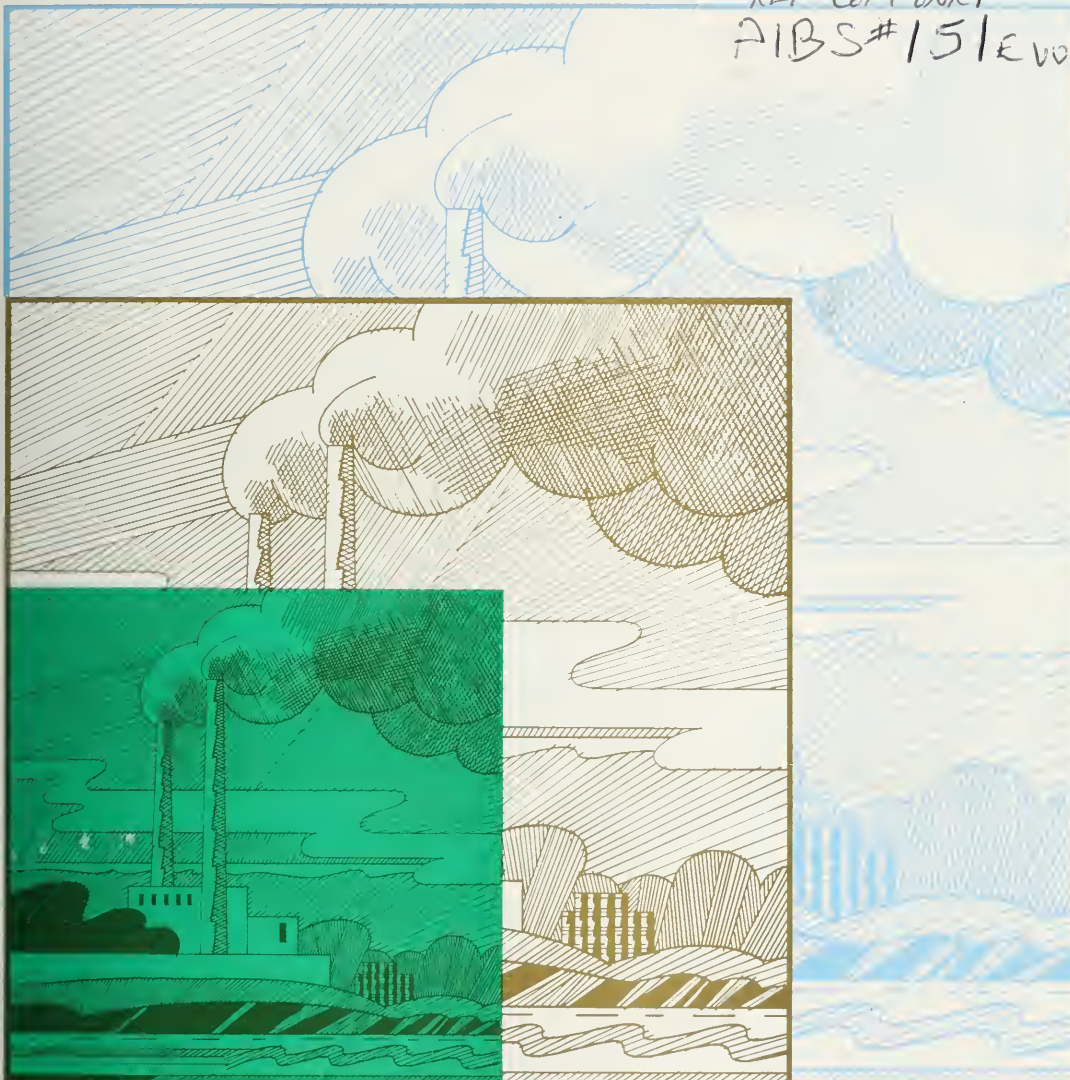

39th Ontario Conference on the Environment

June 14 - 17
1992
The Prince Hotel,
Toronto, Ontario

Proceedings

Environment
Ontario

Proceedings
of the
Thirty-ninth
Ontario Conference on the Environment
held at

The Prince Hotel
Toronto, Ontario

June 14 - 17, 1992

Sponsored by the
Ontario Ministry of the Environment

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WELCOME and OPENING REMARKS

Conference Chairman, Gerry Ronan
Assistant Deputy Minister, Environmental
Sciences and Standards Division
Environment Ontario, Toronto

It is with particular pleasure that I extend to you, on behalf of the Conference organizers, a hearty welcome to the 39th Conference on the Environment.

One of the toughest challenges facing organizers of technical conferences such as this is to continue, year after year, to sustain interest and relevancy in terms of contemporary societal concerns. All too often conferences, such as ours, lapse into the pitfall of straddling too many issues, and as a consequence lose focus, and ultimately lose audience interest.

Another difficulty conference organizers must grapple with is information overload. We are constantly being bombarded with information about the state of our health, our cities, our economy, and last but not least, the state of the environment. People are being forced to develop immune systems to protect themselves from being immobilized by information trauma. Consequently, it is becoming harder and harder to grab our collective attention.

This Conference has demonstrated a durability and relevance second to none. The Conference Planning and Program Committees are to be commended for again crafting an agenda which addresses extremely important environmental issues. They have also brought together a number of first-rate authors and speakers to share with us their insights on these issues. Special thanks go to Ray Stewart, Dave Crump, George Rocoski, Dennis Onn, Janine Zend, John Kinkead, Pat DeAngelis, Bill Bardswick, all from MOE, Murray Greenfield from Dofasco and Eric Veska from Trow Consulting. I should also mention Murray Cheetham, who as always ensures everything runs smoothly in his role of Conference Co-ordinator.

As I have already noted, this is the 39th year of the Environmental Conference, formerly known as the Waste Management Conference. The roots of the Conference go back to the first stirring of environmental awareness in Ontario in the late fifties. It originated as the Industrial Waste Conference, and for the first two decades its primary focus was on promoting technological advances in industrial waste treatment processes.

Perhaps it is a commentary on the glacial rate of change in approaches to reducing pollution that we still devote a major part of our energies in pursuit of better technology trains to treat wastes. Belatedly we are coming to realize that there is a better way to reduce pollution than sole reliance on end-of-pipe technology. The Conference themes reflect this new reality. Waste Reduction, Green Industries and Pollution Prevention are indicative of the new directions being charted. Pollution Prevention, with its emphasis on front-end process changes to reduce the creation of pollutants, holds great promise of being a more effective way of protecting the environment in partnership with the private sector.

The astute mathematicians among you will have realized by now that next year will be the 40th anniversary of the Conference. Conferences, like people, can suffer anxiety pangs at the onset of those dreaded middle years. Some people kick up their heels when they reach this plateau. This Conference is not totally immune to the process. For next year's Conference, consideration is being given to integrating it with other Ministry sponsored events such as the Technology Transfer Conference. The goal would be to provide a forum for the latest developments on green industries, innovative technologies to reduce pollution, sharing information on research and R & D Funding opportunities.

It would be remiss of me if I failed to acknowledge the contribution of the Pollution Control Association of Ontario and the Air & Waste Management Association to these proceedings. Members of both of these Associations are in the environmental protection business for the long haul. Their continuing involvement and support are crucial to the development of innovative technologies and new approaches for the protection and restoration of the environment. We must continue to work together and forge even stronger partnerships with these Associations in pursuit of our shared goal, a Sustainable Environment.

Life is full of surprises. One of them is our new Deputy Minister, Richard Dicerni. Richard was appointed Deputy Minister a few weeks ago. Prior to his appointment, he had been Deputy Secretary to the Cabinet, Federal Provincial Relations Office in Ottawa. He has moved from an area where few outsiders understand what is going on, to a Ministry where everyone knows what is going on, and want their personal imprint on the agenda.

Richard has jointed the Ontario Environment Ministry after a 20 year career with the Federal Government where he held a number of senior positions including Senior Assistant Deputy Minister of Health & Welfare and Assistant Under-Secretary of State. Richard was born and raised in Montreal. He has a Bachelor of Arts from the College Ste. Marie and a Masters in Public Administration from Harvard.

I know Richard is a person who likes to respond to challenges. Moving forward on Ontario's environmental agenda during these tough economic times is not a task for the faint-hearted. Richard has accepted the challenge and privilege of leading the Honourable Ruth Grier's environmental team. Under her leadership the team has been given the task of bringing about fundamental and far reaching changes in Ontario's approach to environmental protection.

I would like to call upon Richard to introduce our Minister, the Honourable Ruth Grier.

June 15, 1992

ONTARIO CONFERENCE ON THE ENVIRONMENT
HISTORICAL DATA

Location	Dates	Sponsor
Ontario Agriculture College, Guelph	1954 to 1956	Pollution Control Board of Ontario
Delawana Inn, Honey Harbour	1957 to 1963	Ontario Water Resources Commission, Water & Pollution Advisory Committee
Bigwin Inn, Lake of Bays	1964 & 1965	Ontario Water Resources Commission, Water & Pollution Advisory Committee
Park Motor Hotel, Niagara Falls	1966 & 1967	Ontario Water Resources Commission
Sheraton Brock Hotel, Niagara Falls	1968 to 1971	Ontario Water Resources Commission
Skyline Hotel, Toronto	1972 to 1974	Ontario Ministry of the Environment
The Prince Hotel, Toronto	1975 to 1992	Ontario Ministry of the Environment

Conference Chairman	Dates	Secretary/ Co-Ordinator
Dr. A.E. Berry	1954 to 1962	D.S. Caverly/M. Grove
D.S. Caverly	1963 to 1973	L.M. Tobias
K.H. Sharpe	1974 to 1976	M.J. Cathcart (1974)
D.P. Caplice	1977 & 1978	
	1975 to 1992	M.F. Cheetham
J.W. Giles	1979 to 1986	
R.M. Gotts	1987	
B.I. Boyko	1988 to 1990	
H.M. Wong	1991	
G.C. Ronan	1992	

Program Conveners

1954-1959	A.V. DeLaporte
1960-1973	F.A. Voege
1974-1978	J.B. Patterson
1979-1992	R.C. Stewart

1993 - 40th ONTARIO CONFERENCE ON THE ENVIRONMENT
TORONTO, ONTARIO
JUNE 13 - 16

CONFERENCE PLANNING COMMITTEE

Conference Chairman
Gerry Ronan,
Assistant Deputy Minister,
Environmental Sciences and
Standards Division,
Environment Ontario, Toronto

Conference Vice-Chairman
Dave Crump,
Director,
Waste Management Branch,
Environment Ontario, Toronto

Program Convener
Ray Stewart,
Manager, Special Projects
West Central Region,
Ontario Ministry of the
Environment, Hamilton

Conference Co-Ordinator
Murray Cheetham,
Ontario Ministry of the
Environment, Toronto

TECHNICAL PROGRAM COMMITTEE

Bill Bardswick, Supervisor, Special Waste Policy and Programs Unit, Waste Management Branch, Environment Ontario, Toronto

Pat DeAngelis, Manager Industrial Approvals Section, Approvals Branch, Environment Ontario, Toronto

Murray Greenfield, Dafasco, Hamilton, for Pollution Control Association of Ontario

John Kinkead, Manager, Watershed Management Section, Water Resources Branch, Environment Ontario, Toronto

George Rocoski, Manager, Waste Management Policy Section, Waste Management Branch, Environment Ontario, Toronto

Janine Zend, Manager, Emission Tech and Regulation Development Section, Air Resources Branch, Environment Ontario, Toronto

Other members of the Committee included: E. Veska, TROW Consulting, Brampton, for the Air and Waste Management Association; and D. Onn, Waste Reduction Office, Environment Ontario, Toronto.

THE PAPERS AND THE AUTHORS

at the

39th ONTARIO CONFERENCE ON THE ENVIRONMENT

JUNE 1992

TORONTO, ONTARIO

Moderator: Richard Dicerni,
Deputy Minister,
Environment Ontario, Toronto

The Honourable Ruth Grier
Ontario Minister of the Environment

George Davies, Deputy Minister
Ministry of Energy,
Toronto, Ontario

Brian Riddell, Assistant Deputy Minister
Municipal Operations,
Ministry of Municipal Affairs,
Toronto, Ontario

Rick Symes, Shoreline Management
Advisor, Royal Commission on the
Future of the Toronto Waterfront,
Toronto, Ontario

Suzanne Barrett, Director
Environmental Studies, Royal
Commission on the Future of the
Toronto Waterfront, Toronto, Ontario

The Honourable Ruth Grier
Minister of the Environment

ONTARIO AND THE ENVIRONMENTAL REVOLUTION
Notes for Remarks
to

39th Ontario Conference on the Environment
June 15, 1992

Good morning: I would like to join our conference chair, Gerry Ronan, in welcoming you to this, the 39th annual Ontario Conference on the Environment.

This year also marks the 20th anniversary of the formation of the Ministry of the Environment in 1972. That's when the ministry replaced the Ontario Water Resources Commission as the patron of this conference. Since 1954, these sessions have consistently anticipated the development of environmental protection in Ontario.

Because this is our event, it has become traditional for the Ministry of the Environment to offer some of the latest developments in technical knowledge and hands-on expertise here. And environment ministers have reviewed many of the new policy directions designed to guide the development and application of that know-how. At last year's conference, for example, I set out in some detail our Waste Reduction Action Plan -- the strategy behind Bill 143 which will move us along the road to a conserver society.

This year is no exception. Today I intend to introduce two new tools which will put Ontario on the leading edge of water quality management and guide us in achieving our water quality objectives in Ontario -- new provincial Fill Quality Guidelines for Lakefilling and Sediment Quality Guidelines.

The Provincial Fill Quality Guidelines are directed strongly toward preventing pollution. They will regulate the fill which may be used in lakefilling projects.

Waterfront renewal has become a major source of economic opportunity for many Ontario communities. This often involves some alterations of shorelines. In addition, lakefilling can be required for flood control, for water diversion or reservoirs, for causeways, docks and footings for bridges and for confined disposal facilities to contain dredged material.

Our government is committed to supporting waterfront renewal by ensuring that its most valuable component -- clean water -- is protected. We will provide this protection by directing more attention to the cumulative effects of changing the shoreline. At the same time we want to establish clear and consistent means of measuring the quality of materials to be used in lakefill.

In one area -- the Greater Toronto bioregion -- I believe this is especially important. The shoreline of Lake Ontario, from Trenton to Burlington Bay, borders Ontario's most heavily populated region.

Two centuries of abuse have changed this shoreline beyond all recognition. Pioneer shipping -- and dredging rocks for ballast from along the shoreline -- destroyed fish habitat and left the lakefront defenceless against erosion. Since the days when Toronto was still known as Muddy York, new land has been built out into the lake. The shoreline has been moved from its original alignment, where Union Station now stands, out to include Harbourfront and as far as the Leslie Street Spit extends.

Industrialization along the shore, development polluting the river systems that feed into the lake, have all taken their toll. The entire lakefront region here is subject to constant pressure for waterfront development, lakefill and shoreline alteration. And nobody has any real understanding or appreciation of the cumulative effects of all of these changes.

The Royal Commission on the Future of the Toronto Waterfront, chaired by David Crombie, from its first public hearings recognized a strong public demand to make Lake Ontario accessible, fishable, drinkable and swimmable.

In its first interim report, the commission raised some significant concerns. I will quote them:

> "While lakefilling operations have had little or no short-term impact on water quality, they do contribute to general sediment contamination , with potentially damaging effects on the biological food chain."
>
> "Extensive modification of the Lake Ontario Shoreline have altered natural coastal processes, causing contaminants to accumulate in sediments; in the past such pollutants would have been carried off shore."
>
> "There has been no comprehensive assessment of the cumulative impact of lakefilling on the Toronto waterfront."

Responding to this in December, 1990, I asked the Royal Commission to address policies, practices, technology and methods available to regenerate the shoreline areas. That is, to establish a shoreline that was healthier and more beneficial to the surrounding community.

In its final report, *Regeneration: Toronto's Waterfront and the Sustainable City*, the Commission recognized a full range of economic and other benefits from lakefilling. These include extensive industrial, commercial and residential development as well as boat berths and sport fishing to benefit recreation and tourism. In addition, the lake has been an inexpensive and convenient repository for material excavated from downtown construction sites.

The other side of the coin has been lakefill material contaminated with lead, other heavy metals and organic materials that have contaminated lake sediments and the food chain. Other lakefill work has filled wetlands and river estuaries, released vast quantities of silt from lakefill sites and damaged natural habitat above and below the water line.

The report concludes that the environmental price was higher than necessary and sometimes outweighed apparent benefits. It points to people or agencies looking at one aspect of a proposal --for example economic feasibility or local benefits -- without regard for the overall impact when combined with other developments.

The Shoreline Regeneration Plan proposed in this report emphasizes four points. They are:

- protection of remaining natural areas
- rehabilitation of degraded areas
- a mechanism for considering cumulative environmental effects and
- improvement of access and recreational opportunities.

We have accepted this recommendation and have already been working with Mr. Crombie on a Greenway strategy which incorporates this regeneration plan.

The Crombie Commission has also called for a moratorium on any significant new lakefill to protect the entire length of the shoreline until studies of its future can be completed. It also recommended that criteria and conditions be established for small or demonstration projects that could be undertaken without compromising the integrity of the Shoreline Regeneration Plan.

These recommendations are based on extensive study and public consultation and the provincial government is taking them very much to heart.

We will take an extremely cautious approach in considering any new major lakefill projects anywhere from Trenton to Burlington Bay. The government has no intention of supporting any further new major lakefill projects, other than carefully-selected demonstrations, until we have a clear understanding of the cumulative effects of existing shoreline work and we have received further advice on the implementation of the Greenway Strategy.

The Crombie Commission, with a mandate from both federal and provincial governments, was a major initiative which built a community consensus on new approaches to improving our environment and our quality of life. And you will hear more about this from Suzanne Barrett, from the Crombie Commission, later this morning.

Lakefill concerns are not confined to the Greater Toronto bioregion. Throughout the province, we have identified a need for more quality control over the material that is deposited in our lakes and rivers.

The Fill Quality Guidelines offer a first step in establishing that clear and consistent measure of quality I mentioned earlier. I have asked our Advisory Committee on Environmental Standards to co-ordinate public consultation and review of these draft guidelines and recommend a sound and practical final set of guidelines based on that review.

This committee is an independent advisory body established for just this purpose. They recommend standards for environmental contaminants as well as policies, principles and procedures for setting environmental standards and public consultation is an important part of this process. Most recently, they provided sound advice on new criteria for the contaminant N-Nitroso Dimethylamine, or NDMA, in water.

Our proposal is that only fill which can be classed as inert fill and will not harm the environment may be considered for lakefill use. Material contaminated beyond that level will be classed as unsuitable. The draft guidelines call for a series of tests for metals and organic compounds. They also require other testing to prevent fill from contaminating sediments and the water.

I intend to apply these fill guidelines throughout Ontario on an interim basis until final guidelines can be established based on full public consultation and the recommendations of the Advisory Committee on Environmental Standards.

The fill guidelines will take effect immediately for all new lakefill projects.

The second major instrument I am announcing in our water quality protection strategy is new Sediment Quality Guidelines which will be put into effect immediately.

Toxic chemicals from industrial and municipal discharges of waste water have accumulated in sediments throughout our rivers and lakes and especially in the Great Lakes. The damage has been compounded by other sources, including the runoff from farm fields and city streets, lakefilling with contaminated materials and deposition of fallout from the air. These contaminated sediments are a reservoir for persistent toxic chemicals that break down slowly and re-enter the water.

The new guidelines will provide a basis for managing the areas where these sediments are continuing to degrade water quality. They will also provide a yardstick to assessing current water quality conditions and anticipate the potential impact of new developments.

The Guidelines will establish safe levels for metals, nutrients and organic compounds. And for the first time, these levels have been based on biological impact. They assess sediments in terms of effects on sediment-dwelling organisms and other aquatic life.

We intend to integrate these guidelines into our overall provincial water quality strategy. This includes ministry programs such as MISA – our Municipal Industrial Strategy for Abatement, the Beaches Improvement Program and the Clean Up Rural Beaches Program, as well as other provincial water strategies.

Adoption of the Sediment Quality Guidelines will put Ontario in the forefront of sediment management in North America. They will guide our ministry in assessing the quality of sediment in our water quality programs. With these guidelines, environmental managers can determine:

- when sediment may be considered clean

- what levels of contamination are acceptable for short periods of time while the source of the contamination is being controlled and cleanup plans are being developed

- what levels of contamination are considered severe enough to warrant removing the sediment.

The guidelines will also provide a consistent measure of environmental quality to assist both the public and private sectors as they address such issues as:

- the extent of cleanup required after a spill

- placement of material dredged from the bottom of a waterway and

- specifying which excavated material may be used for lakefilling.

In addition to assisting local community officials in waterfront management, this initiative will help us meet our international obligations under the 1987 Protocol to the Great Lakes Water Quality Agreement. We have consulted extensively on the guidelines with the various interests involved in the federal-provincial Remedial Action Plans. As you know, local RAP teams are developing management plans for contaminated sediments in the 17 areas of concern identified by the International Joint Commission along the Ontario side of the Great Lakes.

The new sediment guidelines will provide a valuable gauge to determine existing contamination and establish cleanup priorities as well as guiding us in preventing pollution.

In addition, where fill projects are contemplated in future, the sediment and fill guidelines will complement and reinforce each other in protecting and restoring water quality. They will work together to prevent sediment from becoming contaminated.

For example, the sediment in a particular area may be contaminant-free, supporting healthy aquatic life and offering excellent swimming and fishing opportunities. Then we must ensure that any material used in that area does not degrade that high standard of environmental quality.

Similarly, if there are grounds for concern about the quality of the existing sediment, then the fill material quality should not compound those concerns and further degrade water quality.

In the Ministry of the Environment we are moving into a new generation of environmental policy with the emphasis shifting from controlling pollution to preventing pollution. This involves fundamental changes for both government and industry in our approach to environmental protection. It is no longer enough to react to issues, often after the pollution problem has become acute. Government and industry must anticipate pollution problems and prevent them from happening. This calls for approaches which incorporate environmental considerations into social and economic decisions.

Prevention is based on a simple principle; if you don't create pollution in the first place, you won't have to run the risk of harming environmental and public health or invest in costly cleanup mechanisms. For industry this means overcoming its reliance on end-of-pipe technology; introducing source control and closed-loop systems within plants to prevent the discharge of contaminants into the environment; substituting raw materials to avoid the generation of harmful byproducts or waste; and, introducing process changes and product redesign to minimize the amount and degree of hazard in the waste stream.

This concentration on improving processes and reducing wastes opens the door to new efficiency and economy. This is the ideal in pollution prevention, and the industries who have been monitoring their discharges, as part of the MISA program, are taking it seriously.

In the petroleum sector, for example, four Ontario refineries were using zinc-chromium based additives in their cooling water towers. They found high levels of these metals in their discharges with some evidence they were toxic to the rainbow trout used in the monitoring. All four have replaced this toxic compound with an organophosphate. This inhibits the growth of slime and micro-organisms in their cooling water towers and eliminates the metals discharges.

Northern Telecom, when they looked closely at their use of CFCs in their operations, discovered they could eliminate them entirely from their plant. The result was a better product, a more efficient process and substantial savings in the chemicals they no longer need to buy.

I am sure you will hear of more examples in today's session on corporate greening and tomorrow's pollution prevention session.

Under a federal-provincial Memorandum of Understanding I signed last month, the automaking industry has become Ontario's first industrial sector to formally introduce a voluntary program aimed at preventing pollution.

In its role as one of this province's economic engines and the source of many jobs, automaking also contributes to the contamination of our air, land and water. The pollution prevention agreement is a major step in turning this situation around and I believe it will help establish a pattern for developing similar initiatives with other industries.

The memorandum emphasizes reducing the use of toxic chemicals. It also emphasizes the transfer of technology, encourages pollution prevention within all sectors of the industry and adopts a multi-media approach, which recognizes that the contamination of air, water and land cannot be treated in isolation.

The memorandum shows what can be accomplished when governments and industry form productive partnerships. And I am pleased that the industry's task force will be meeting with representatives from environmental groups and labor in the same spirit of co-operation.

Controlling pollution and planning based on total ecosystem impact is, I am sure, familiar to those of you who have been active in the development of Ontario's Municipal Industrial Strategy for Abatement. MISA is environmental policy that involves fundamental changes in our approach for both government and industry. And Jim Ashman, director of our water resources branch, will go into more detail tomorrow on the ways we are working with industry to incorporate environmental protection into industrial policy, production and processes.

Also tomorrow, Jim Smith, who heads our new pollution prevention team, will be outlining the next step in Ontario's pollution prevention strategy. We have set our sights on toxic chemicals in the environment. We have identified a candidate list of 21 highly hazardous substances which we believe should be phased out or banned in Ontario.

We have released this list to the federal government and we have asked Environment Canada to use it in their consultation with industry, government, environmentalists and the public to establish national priority for phasing out toxic chemicals.

All these developments are part of the new generation of environmental policy and a new approach to environmental legislation. Traditionally, governments have set limits to the levels of specific contaminants that can be released, based on the estimated capacity of the environment to absorb damage. Instead of setting limits to potential damage, we are concentrating on preventing damage. At the same time, we are working out more effective and efficient ways to operate. Rather than reacting to the impact of technology, the new generation of regulation is driving technology and innovation.

To put it in the broadest possible terms, our objective is to promote and encourage change in the basic operation and behavior of individuals, institutions and industry, to prevent pollution and protect our environment and, at the same time, to invigorate our society and our economy.

And I think most of you here share that objective. You are all, one way or another, practical, working environmentalists.

In the Worldwatch Institute report, *State of the World 1992*, Lester R. Brown introduces the concept of the Environmental Revolution. He sees it as a social development as significant to human development as the Agricultural and Industrial Revolutions that marked the world's major social transitions. His question is:

> "Will the change come from strong worldwide initiatives that reverse the degradation of the planet and restore hope for the future, or will it come from continuing environmental deterioration that leads to economic decline and social instability."

His concern is that the Environmental Revolution has so far been regarded as a spectator sport, where most sit in the stands and watch as a handful on the playing field actively try to influence the outcome of the contest.

I believe all of us here are on the playing field. We are all working in the same direction toward the same goal -- building an environmentally, economically and socially sustainable future for this province. We face the continuing challenge of getting all of the spectators committed to that goal and working toward it.

That is our essential challenge. We will learn something here from each other. We will meet people who may have ideas that can help us with our individual challenges. We will not, however, solve all of Ontario's environmental problems in three days.

The important thing, for all of us, is to build on our progress and to keep working to make this province a better place to live.

ENVIRONMENT INFORMATION - ENVIRONNEMENT

SUMMER 1992

Ontario Environment Environnement

BACKGROUNDER ON PROVINCIAL SEDIMENT QUALITY GUIDELINES

The accumulated organic and mineral debris which sits on the bottom of a lake, river or stream is called sediment. It is home to the small bottom-dwelling organisms, such as midges and worms, which fish eat.

The Ministry of the Environment has singled out contaminated sediment as a particular environmental problem. The ministry is concerned for two reasons:

• First, sediment acts as a reservoir for persistent toxic chemicals - poisonous substances which take a long time to break down. It holds them and releases them slowly into the water.

• Second, toxic chemicals accumulate in catfish, carp and other fish that feed on the bottom of lakes and rivers, and in the bottom-dwelling organisms (also called the benthic community). These chemicals may be transferred to fish either because they ate the organisms or because the fish swam too close to the contaminated sediment. These chemicals may be transferred again, and at levels which may present a health risk, to wildlife, birds and people who eat the fish. This process is called biomagnification.

SOURCES OF CONTAMINATION

The primary source of contaminants in sediment is toxic chemicals from industrial and municipal discharges of waste water. The chemicals and heavy metals, such as mercury, copper and polychlorinated biphenyls (PCBs) and some persistent pesticides, such as DDT, attach themselves to floating particles, soil for example, which eventually sink and settle on the sediment. Other sources include:

• Chemicals in factory emissions which attach themselves to particles of dust or droplets of water and fall back to the earth in the form of dust, rain, sleet, hail or snow;

• Runoff from cities, towns and agricultural areas, which may contain pesticides, phosphorus, metals, oil and gasoline;

• Lakefilling, or the practice of creating more land by building up the shoreline with rubble, bricks, stones, concrete and loose earth - commonly called fill. If the fill is contaminated, then the toxic chemicals may reach the water and eventually the sediment. This may happen in two ways. Fill may be washed away during construction by strong waves, currents or heavy rain, or the chemicals in the fill may leach into the lake or river.

MINISTRY OF THE ENVIRONMENT'S RESPONSE

The ministry has several programs in place which, either directly or indirectly, tackle the problem of contaminated sediment.

• *The Remedial Action Plan (RAP) Program* - The aim of the program is to help clean up the 17 Areas of Concern in the Great Lakes in Ontario which were identified by the International Joint Commission as being badly contaminated. RAP teams have pointed to contaminated sediment as one of the factors contributing to poor water quality and to poor living conditions for the benthic or bottom-dwelling community.

• *The Municipal/Industrial Strategy for Abatement (MISA)* - The aim of the program is to prevent pollution by reducing, and in some cases, eliminating the discharge of contaminants into the province's lakes and rivers.

• *Operation Lifeline and the Beaches Improvement Program* - The aim of these two programs is to help municipalities improve storm water management and reduce the amount of runoff from cities and towns.

Until recently, the ministry used the 1976 Open Water Disposal Guidelines to help protect the quality of the sediment. The guidelines were developed originally to determine whether or not material dredged from the bottom of a lake or river was suitable for disposal in open water. Over time they were applied to sediment.

Now the ministry has developed the *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario* and the *Fill Quality Guidelines for Lakefilling in Ontario*. The new guidelines together with the forthcoming Materials Management Policy for soil, rock, rubble, sand, concrete, clay, other soil and rock-like materials and the fill used for lakefilling will help to improve the quality of sediment and to prevent its contamination in the future.

THE SEDIMENT QUALITY GUIDELINES

The purpose of the sediment quality guidelines is to protect the aquatic environment by setting safe levels for metals, nutrients (substances which promote the growth of algae) and organic compounds.

The guidelines are designed to help environmental managers - ministry officials and environmental consultants - make decisions on a whole range of issues that affect the quality of sediment.

In particular, the guidelines will be used by the RAP teams - the driving force in the guidelines' development - to determine which sediments are contaminated and how to organize the cleanups.

HOW THE GUIDELINES WORK

The guidelines establish three levels of effect - No Effect Level, Lowest Effect Level and Severe Effect Level. The Lowest and Severe Effect Levels are based on the long-term effects which the contaminants may have on the sediment-dwelling organisms. The No Effect Level is based on a level of chemicals which is so low that no contaminants are passed through the food chain.

The levels of effect will help environmental managers determine:

• when sediment may be considered clean;

• what levels of contamination are acceptable for short periods of time while the source of the contamination is being controlled and cleanup plans are being developed;

• what levels of contamination are severe enough to consider the possibility of either removing the sediment or covering it with a layer of cleaner sediment. This is called capping.

The three levels of effect are:

• **The No Effect Level:** This is the level at which the chemicals in the sediment do not affect fish or the sediment-dwelling organisms. At this level no transfer of contamination through the food chain and no effect on water quality is expected.

The No Effect Level is the maximum concentration of chemicals in the sediment at which no effect is observed in fish or bottom-dwelling organisms. A better rating than No Effect is a zero rating or no chemicals at all in the sediment.

Sediment that has a No Effect Level rating is considered clean and usually no management decisions are required. Furthermore, the sediment may be placed in rivers and lakes provided it does not physically affect the fish habitat or existing water uses - such as block a drinking water supply pipe.

• **The Lowest Effect Level:** At this level, the chemicals in the sediment have no effect on the majority of the sediment-dwelling organisms. The sediment is clean to marginally polluted.

Dredged sediments containing concentrations of organic contaminants - PCBs or pesticides, for example - that fall between the No Effect Level and the Lowest Effect Level may not be disposed of in an area where the sediment is considered clean. That is to say, the sediment near the proposed disposal site has been rated at the No Effect Level or better.

Similarly, material for lakefilling projects which testing has determined meets the Lowest Effect Level may be placed only in an area where the contamination in the existing sediment has also been classified at the Lowest Effect Level.

Contamination in sediment that exceeds the Lowest Effect Level may require further testing. In addition, a management plan may be needed to prevent further contamination.

• **The Severe Effect Level:** At this level, the sediment is considered grossly polluted and likely to affect the health of sediment-dwelling organisms. If the level of contamination exceeds the Severe Effect Level then testing is required to determine whether or not the sediment is acutely toxic.

At the Severe Effect Level, a management plan will be required. The plan may include controlling the source of the contamination and removing the sediment.

Some examples of the guidelines include:

	No Effect	Lowest Effect	Severe Effect
Lead	-	31 parts per million (ppm)	250 ppm
Mercury	-	0.2 ppm	2.0 ppm
Arsenic	-	6.0 ppm	33 ppm
Phosphorus	-	600 ppm	2000 ppm
PCB (total)	0.01 ppm	0.07 ppm	530 ppm*
PAH (total)	-	[2] ppm	[11,000] ppm*

Footnotes

• **The square brackets mean the guidelines are interim.**
• **The dashes mean that the numbers are still being developed.**

* **For a number of compounds including specific PCBs and PAHs, the sediment quality guidelines provide a formula for calculating the numbers for the Severe Effect Level. For more information please refer to the Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario.**

THE FILL QUALITY GUIDELINES FOR LAKEFILLING IN ONTARIO

The fill quality guidelines regulate the fill which may be used in lakefilling projects. Only fill which according to the forthcoming Materials Management Policy guidelines meets the chemical criteria required to be classified as inert material may be used as fill for lakefilling projects. The fill which may be used for lakefilling projects is divided into two categories - confined fill and unconfined fill.

• Confined fill may be used for lakefilling projects provided it is placed within the confines of a structure, such as a dyke, which is capable of withstanding the waves of a once-in-50-years storm. The intent is to prevent the fill from coming into contact with the open water and, in the event of a storm or high waves, being washed away.

• Unconfined fill may be placed directly into the water, but must pass a series of tests including:

- bulk chemical tests for 11 metals and organic compounds such as PCBs, arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, total organic carbon and total phosphorus. The tests are set out in the guidelines.

- the Receiving Water Simulation Test which determines whether or not organic compounds such as PCBs leach out from the fill. The material is checked by putting it into a container of water and shaking it. The water is tested and must pass the Provincial Water Quality Objectives.

- other tests which the ministry may request on a case-by-case basis.

The two sets of guidelines work together to prevent sediment from becoming contaminated. For example, the concentrations of organic compounds in material for a lakefilling project must not exceed the No Effect Level if the quality of the sediment near the project is rated at the No Effect Level. Similarly, if the quality of the sediment meets the Lowest Effect Level, then the fill material quality must not exceed the Lowest Effect Level. Finally, if the fill material exceeds the Lowest Effect Level then the fill is treated as confined fill.

For more information on the fill quality guidelines please see the Ministry of the Environment's backgrounder on Provincial Fill Quality (PIBS 1967B) and the Fill Quality Guidelines for Lakefilling in Ontario (PIBS 1963).

For more information on sediment quality please see the Guidelines for the Protection and Mangement of Aquatic Sediment Quality in Ontario (PIBS 1962).

To obtain the publications listed above please contact the Ministry of the Environment, Public Information Centre, 135 St. Clair Ave. W., Toronto, Ont. M4V 1P5, (416) 323 4321, toll free 1-800-565-4923.

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FILL QUALITY GUIDELINES FOR LAKEFILLING IN ONTARIO

APPLICATION OF SEDIMENT AND WATER QUALITY GUIDELINES TO LAKEFILLING

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The Fill Quality Guidelines

Only material rated as inert fill according to the guidelines accompanying the forthcoming Materials Management Policy may be used as fill for lakefilling projects. The fill which may be used for lakefilling projects will be divided into two categories - Confined Fill and Unconfined Fill:

- Confined fill may be used for lakefilling projects provided it is placed within the confines of a structure, such as a dyke, which is capable of withstanding the waves of a-once-in-50-years storm. The idea is to prevent the fill from coming into contact with the open water and, in the event of a storm or high waves, being washed away.

- Unconfined fill which may be placed directly into the water must first pass a set of stringent tests including:

  - bulk chemical tests for 11 metals and organic compounds including polychlorinated biphenyls (PCBs), arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, total organic carbon and total phosphorus.

  - the Receiving Water Simulation Test which determines whether or not organic compounds such as PCBs leach out from the fill. The material is checked by putting it into a container of water and shaking it. The water is then tested and must meet the Provincial Water Quality Objectives which protect fish and other aquatic life.

  - further tests which the ministry may order on a case by case basis. The tests may include chemical analyses for nutrients, other metals and organic compounds in the new Provincial Sediment Quality Guidelines.

  Unconfined Fill must meet the Lowest Effect level of the sediment guidelines for organic parameters and either the Lowest Effect Level or what is called the background level of the sediment for metals. The background level is the quality of the sediment before it was affected by industrialization. The Lowest Effect Level is the level of contamination in the sediment at which testing shows there is no toxic effect on the majority of sediment-dwelling organisms. Such sediment is clean to marginally polluted.

  In addition, the fill must not affect the quality of the sediment or kill sediment-dwelling organisms and fish. The fill must be free of substances which could accumulate in organisms or which could form objectionable deposits - such as scum - or ruin the potential of the water for recreation or as a habitat for aquatic life, such a fish, worms and midges.

Fill that fails the tests for Unconfined Fill may qualify as Confined Fill if it meets the requirements for Confined Fill. Material that fails the requirements for Confined Fill must be managed as a waste as described in Regulation 309 under the Environmental Protection Act and/or the procedures described in the proposed Materials Management Policy.

While the lakefilling project is being built all reasonable measures must be taken to keep the water as clear as possible and to reduce the loss of fill. Fill is lost when waves wash it into the lake or river or when the fill does not sink when placed into the water but becomes suspended turning it brown and gritty. Some precautions may include dumping fill only when the water is calm and protecting all exposed areas of the lakefill project from severe storms by dykes and enclosures to prevent erosion.

Guideline Benefits

The guidelines will help environmental managers, who include conservation authority officers and Ministry of the Environment and harbour commission employees, determine what material may be used in lakefill projects.

EXECUTIVE SUMMARY

Introduction

The purpose

The purpose of Ontario's new Fill Quality Guidelines is to protect the quality of the water in the province's lakes and rivers and to prevent pollution from occurring in the future. The guidelines regulate the quality of the fill which may be used in projects ranging from lakefilling as part of urban water front renewal to the construction of a cottage dock. The Fill Quality Guidelines, together with the Provincial Sediment Quality Guidelines will enhance protection of the aquatic environment.

Lakefilling

Lakefilling is the practice of creating new land by placing rubble, stones, concrete, bricks and loose earth into shallow areas in lakes and rivers.

The most obvious example of lakefilling is the Metropolitan Toronto harbour area. Most of the land on which the present Harbourfront development now stands, for instance, was created by lakefilling projects before 1930. The Stelco Pier in Nanticoke on Lake Erie is another example. The 1,191 metres (3,906 feet) dock and causeway is used for unloading and loading raw materials and finished goods transported by Great Lakes ships.

Some of the benefits of lakefilling projects include the creation of land for parks, marinas and wildlife preserves as well as protection of shorelines from erosion or floods.

Monitoring of some existing sites suggests that the fill used has degraded the quality of the water and sediment and has harmed sediment-dwelling organisms, such as worms and midges, which fish eat.

Existing Regulations

Today, most major lakefilling projects proposed by ministries, municipalities or conservation authorities become subject to the Environmental Assessment Act because they are part of a larger project, such as a waterfront park, which is subject to the act.

Private lakefilling proposals may also be designated under the Environmental Assessment Act, if the minister believes that the lakefilling part of a project or the whole project - a marina and waterfront recreation centre, for example - is significant.

All lakefilling projects must meet the requirements of the province's Lake and Rivers Improvement Act administered by the Ministry of Natural Resources (MNR) and the federal Fisheries Act which MNR administers on behalf of Fisheries and Oceans Canada.

Until now, the fill which was placed directly into the water had to meet the requirements of Ontario's Open Water Disposal Guidelines for sediment. These guidelines were developed to determine whether or not dredged material was suitable for disposal in open water, but have been used recently to evaluate potential fill. The new Fill Quality Guidelines for Unconfined Fill replace the Open Water Disposal Guidelines.

Today, if a project is approved under the Environmental Assessment Act and conforms to the Lakes and Rivers Improvement Act and the federal Fisheries Act, then the material to be used as fill must meet the requirements of the Fill Quality Guidelines.

The guidelines will also complement existing ministry programs for protecting water quality. They include:

- The Municipal Industrial Strategy for Abatement (MISA) - The aim of the program is to reduce and, in some cases, to eliminate discharges of toxic chemicals from industry and municipalities;

- The Remedial Action Plan (RAP) program - The aim of the program is to help clean up the 17 Areas of Concern in the Great Lakes in Ontario which the International Joint Commission identified as being badly contaminated;

- Operations Lifeline, a program to upgrade sewage works, and the Beaches Improvement Program - The aim of these programs is to help improve storm water management.

For copies of the Fill Quality Guidelines for Lakefilling in Ontario, please contact the Public Information Centre of the Ministry of the Environment, 135 St. Clair Ave. W., Toronto, Ontario. M4V 1P5. (416) 323-4321.

FOREWORD

The guidelines provided in this document were developed for evaluating the suitability of fill material for lakefilling. They are designed to protect the aquatic environment from both the physical effects of, and contaminants associated with lakefill materials. The guidelines incorporate features of the Provincial Sediment Guidelines to ensure protection of sediments and the Provincial Water Quality Objectives to ensure protection of water quality and water uses. Some provisions in this document relating to the suitability of fill material for lakefilling, specifically the use of the Confined Fill Guidelines, contain references to material in the Policy for the Management of Excess Soils, Rock, and Like Materials (in preparation).

In addition to the protection of water and sediment quality, many other issues such as habitat alteration, alteration of current patterns, and siting and design, must be addressed before a lakefill can be built. These other issues will be addressed in a Provincial Lakefill Policy currently under development.

Ministry requirements in these Guidelines will not exempt projects from current evaluation procedures under other legislation administered by this Ministry, or by other Ministries or agencies. Proponents are responsible for complying with all appropriate policy and regulations in this regard.

1. INTRODUCTION

Lakefilling refers to the placement of solid material (e.g., loose earth, rubble, broken concrete) in or abutting a waterbody (lakes and rivers) to create structures for flood and erosion control (e.g., shoreline protection or stabilization works), land creation (e.g., waterfront parks and recreational boating facilities) and confined disposal facilities for dredged material.

1.1 Lakefilling in Ontario - Background

Most of the large lakefills for the purpose of land creation have been centred in the western basin of Lake Ontario, especially the area adjacent to the Metro Toronto waterfront. The Toronto Harbour Commission, under Federal charter, has been using this technique to develop the Toronto waterfront since 1911. Over the past 25 years, the Commission has been involved in the construction of the Eastern Headland (also known as the Leslie Street Spit) which is the largest lakefill structure in Lake Ontario.

During the late 1960's and 1970's, the conservation authorities bordering western Lake Ontario and other government agencies (e.g., municipalities, Government of Ontario) proposed shoreline plans which included varying degrees of land creation through lakefilling.

Creation of new land resources through filling in the littoral (shallow, near-shore) zone can be an appealing concept for several reasons. With lakefront property commanding a premium price, the creation of new land by lakefilling is attractive, particularly in the heavily populated western basin of Lake Ontario. In many cases, lakefills provide recreational opportunities that would otherwise not exist and could not be provided through the purchase of existing shoreline properties. In addition, the filling activity provides construction interests with an inexpensive means of disposing of large quantities of waste excavation material and rubble.

Concerns over the environmental implications of lakefilling that have been consistently raised over many years have recently heightened across Ontario, particularly in the Metro Toronto area.

The impact on the aquatic environment of building lakefills using the present methodology has not been adequately assessed. However, monitoring of existing sites has, in some cases, indicated degraded soil, water and sediment quality, and disruption of aquatic communities in the vicinity of lakefill structures.

A main area of concern has centred around the quality of the material that has been used in lakefills. Monitoring of fill quality has indicated that material with the potential to impair water and sediment quality has entered lakefills.

1.2 A Fill Quality Program

The Guidelines which follow have been developed to provide environmental protection from the loss of fill and associated contaminants during lakefilling. They are meant to ensure that lakefilling does not significantly impair water quality, aquatic habitat, and adjacent uses from the loss of fill.

Criteria to address aquatic environmental concerns have been developed such that the quality of fill and method of placement will ensure compliance with:

- The MOE water quality management goal: "To ensure that the surface waters of the province are of a quality which is satisfactory for aquatic life and recreation" (MOE, 1984)

- The Provincial Sediment Quality Guidelines: to protect organisms that are directly impacted by contaminated sediment, namely the sediment-dwelling (benthic) species; and to protect against biomagnification of contaminants through the food chain from sediment contaminant sources.

In addition to the protection of water and sediment quality, many other issues must be addressed before a lakefill can be built. These guidelines do not address these other issues.

2. ENVIRONMENTAL CRITERIA

2.1 General

During construction of a lakefill, major aquatic effects are associated with loss of fill material along with the contaminants associated with the fill. These effects may be chemical or physical.

Chemical effects are associated with changes to water and sediment quality. Physical effects are two-fold: the effects of suspended sediment on water quality, specifically, on turbidity; and, the effects of deposited sediment on aquatic habitat.

Environmental criteria outlined here are designed to determine the acceptability of fill and on-site placement of lakefill materials. These criteria identify two categories of acceptable fill: Confined and Unconfined Fill. The screening system is outlined in Figures 1 to 3.

- Confined fill: material that meets the initial screening criteria only.

- Unconfined fill: material that meets the initial screening criteria as well as additional more restrictive criteria.

If lakefilling material meets the criteria for Confined Fill, the proponent at this point has a choice of following the conditions for placement of Confined Fill, or proceeding to determine if the material meets the criteria for acceptability as Unconfined Fill.

2.2 Chemical Effects

2.2.1 Confined Fill Material Criteria

Confined Fill criteria are based on the protection of the terrestrial environment. The Materials Management Policy Committee is preparing these criteria which are scheduled for completion at the end of 1992. At that time, material for use as Confined Fill must meet the inert fill guidelines outlined in the proposed Policy for Management of Excess Soils, Sediments and Like Materials. In the interim, fill material for use as Confined Fill must meet the Confined Fill Guidelines (Interim) as listed in Appendix B.

Initial acceptability of the lakefill material is determined on the basis of:

- The material meets the Confined Fill Guidelines (Interim) in Appendix B. Sampling and analytical protocols to be followed are described in the document *Sampling and Analytical Protocols* developed as part of the Proposed Policy for Management of Excess Soil, Rock and Like Materials

Material not meeting these criteria will be considered unacceptable for lakefills. Fill material that passes these criteria qualifies as Confined Fill and can be used for lakefilling if the following conditions are met:

- Confined fill is placed within a confining structure such that there will be no loss of material to the surrounding aquatic environment.
- The confining structure is designed to withstand the most significant wave that could occur in storms over a 25-year period. The placement of confined fill can occur only after such a confining structure is completed.

- The confining structure is protected to the estimated 50-year storm significant wave prior to the end of the calm period* during which confined fill was first deposited.

2.2.2 Unconfined Fill Material Criteria

In order to qualify as Unconfined Fill, material passing the criteria referred to above must not impair sediment quality (Persaud *et al.* 1992) and must also meet the following criteria (OMOE 1984):

- The material must be free of substances that could form objectionable deposits (e.g., scums, oil, floating debris, etc.) or impart colour, odour or taste to water.

- The material must be free of substances that could cause "rapid lethality" to aquatic life.

- The material must be free of substances that could result in significant bioaccumulation in aquatic organisms.

- The material must not create water quality conditions that would impair the health and well-being of aquatic life and other normal water uses.

The following tests must be carried out to determine acceptability of fill material according to the above criteria. A mandatory list of parameters requiring analysis is given in Table 1. Other parameters from the Provincial Sediment Quality Guideline list (Tables 1 and 2 of Appendix A) may be required on a case-by-case basis after review of the history of the site where the material originated.

Table 1: Mandatory Parameter List for Unconfined Fill

PCBs
Arsenic
Cadmium
Chromium
Copper
Lead
Mercury
Nickel
Zinc
Total Organic Carbon
Total Phosphorus

In order to qualify as Unconfined Fill, the material must first meet the Site-Specific Suitability chemical criteria discussed below and outlined in Figures 2 and 3. Candidate material will be tested by bulk chemical analysis and results reported on a dry weight basis (OMOE (1983) or approved equivalent analytical procedures).

In addition, the material must also meet a visual screening test (Objectionable Substances) and a Receiving Water Simulation test in order to qualify as Unconfined Fill.

Material that meets these criteria qualifies as Unconfined Fill and is suitable for use in direct contact with open water.

Site-Specific Suitability of Fill

Organic Compounds

If sediment quality in the vicinity of the lakefill (i.e., ambient sediment quality) is equal to or better than the No Effect Level of the Provincial Sediment

* Calm period is normally considered to be the period from June through August when the normal climatic conditions do not generate any sustained high energy waves. This period may be extended on a case-specific basis if it can be demonstrated, based on climatic records (i.e., wind and wave data) (OMNR 1988), that the occurrence of significant waves greater than 0.5 m will occur with an expected probability of <25%.

Table 2: Background Levels for the Metals

Metal	Background (µg/g dry wt.)
Arsenic	4.2
Cadmium	1.1
Chromium	31
Copper	25
Iron (%)	3.12
Lead	23
Manganese	400
Mercury	0.10
Nickel	31
Zinc	65

Values are based on analyses of Great Lakes pre-colonial sediment horizon.

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Quality Guidelines (Appendix A) then the fill material quality must not exceed the No Effect Level (Figure 2).

If sediment quality (ambient) exceeds the No Effect Level but meets the Lowest Effect Level of the Provincial Sediment Quality Guidelines (Appendix A) then fill material quality must not exceed the Lowest Effect Level.

If fill material quality exceeds the Lowest Effect Level, the fill does not qualify as Unconfined Fill.

Other Parameters

If ambient sediment quality in the vicinity of the lakefill is equal to or better than the Lowest Effect Level then the fill material quality must not exceed the Lowest Effect Level (Figure 3).

If ambient sediment quality exceeds the Lowest Effect Level then fill material quality must be equal to or better than ambient, provided that the quality of the fill material does not exceed the pre-colonial background as defined in Table 2.

Objectionable Substances

The fill material will be thoroughly screened (visually) to ensure it is free of substances such as vegetation, wood, paper, plastic products, metal scraps, odoriferous and colour-imparting materials.

Receiving Water Simulation

Tests for bioaccumulation, and water quality impairment will be carried out by using a test which simulates the water column at the fill face, as described below.

The water column at the fill face will be simulated by placing one part of fill material to twenty parts of distilled water on a weight-to-weight basis and agitating the mixture for 24 hours. After a settling period of one hour, aliquots of the supernatant will be decanted and used in the following test:

> The supernatant will be analyzed for the presence of bioaccumulative organic compounds in the mandatory list (Table 1) and others as may be required on a case specific basis where parameters in Appendix A (Table 2) exceed the No Effect Level guideline in a bulk chemical analysis. The concentration of these substances in the supernatant must be below the Provincial Water Quality Objectives/Guidelines (PWQO/G).
>
> The supernatant will also be analyzed for the other parameters (Table 1) that are known to be present in the material based on bulk chemical analysis. The concentrations of the substances (with the exception of mercury) will not exceed ten times the PWQOs/Gs (this assumes a 10:1 dilution in the near field of the dumping operation; if the dilution is less than 10:1, the appropriate factor applies). Concentrations of mercury will not exceed the PWQO in the supernatant because of its high bioaccumulative potential.

Only when all of the above criteria have been met is the material acceptable as Unconfined Fill.

2.2.3 Rationale - Chemical Effects

When contaminants in fill are lost to the aquatic environment they will either become dissolved in water or remain associated with particulate matter which will eventually settle to the bottom. Contaminants associated with material in a lakefill may also migrate with groundwater and reach the lake.

Contaminants in the water column, either in solution or associated with suspended particulate matter, can have a wide range of effects. These include exceedances of drinking water objectives (with potential human health implications), direct toxicological effects on aquatic biota, bioaccumulation of contaminants through the food chain with possible toxicological effects on predators, and restrictions on commercial management of fish or on sport fish consumption.

Most studies related to lakefilling have concluded that water quality effects are localized, with infrequent detection of nutrients, metals and organics above PWQOs. Neither acute nor chronic biological effects have been documented and, in any case, detecting such effects in the field would be a difficult task.

A PWQO is designed to protect the most sensitive water use whether it be for the protection of aquatic biota, recreation or other uses, and as such it can be used as the "no effect" level. In the vicinity of lakefills, the PWQOs/PWQGs are not routinely violated but are occasionally exceeded. Since acute biological effects in these areas have not been observed, it can be assumed that lakefilling has not had acute toxicological effects on pelagic biota (biota ranging throughout the water column). However, chronic effects may have occurred in localized areas near active filling where PWQOs or PWQGs have been exceeded. Contaminants in fill can also enter the groundwater and migrate to a lake or river. The rate of migration of contaminants in groundwater is expected to be slow, but some migration is nevertheless expected. This aspect will be addressed in the Policy for the Management of Excess Soil and Soil-like Material.

Fill lost to the aquatic environment from a lakefill site is eventually deposited on the bottom. Most will be deposited in the vicinity of the lakefill, at least on a temporary basis. Studies have found elevated levels of some contaminants in biota and sediment in the vicinity of lakefilling operations on the Toronto waterfront; however, it is often difficult to separate the effects of lakefilling from other point and non-point sources of contaminants.

There is little information on uptake of contaminants by biota in the vicinity of lakefills under construction. It can be reasonably assumed that, if the sediments lost during the filling process are contaminated, and there are no other significant sources of contaminants, then aquatic biota in areas adjacent to lakefilling will have higher contaminant body burdens than in areas not influenced by lost fill. Therefore, it is prudent to minimize the loss of fill, and to ensure that any fill lost is not contaminated.

2.3 Physical Effects

2.3.1 Turbidity Criteria

All reasonable measures will be taken during filling operations to minimize turbidity levels. Specific mitigative measures will be determined on a site-specific basis in consultation with Ministry staff, but will include the following general measures:

- Filling in areas exposed to wave action will occur only during a defined "calm" period. During other periods, filling will occur only in protected areas, not prone to wave attack.
- The exposed fill face will be restricted to a specific length, usually 15 metres. All other areas must be protected with erosion-resistant material to withstand, as a minimum, the annual storm event.
- All areas exposed to wave attack must be protected, prior to the end of the calm period, against the estimated 25-year storm significant wave - if confined fill has been used, then the Confined Fill criteria will apply.

Where sensitive water uses are identified, turbidity levels must be within the specifications of the PWQO/PWQG. Site monitoring may be required to ensure compliance with PWQOs/PWQGs. If violations occur, then the proponent will take corrective action immediately, according to the project's contingency plan, in which the proponent identifies essential controls and/or mitigative measures to be taken if violations occur. Such measures may include installations of silt curtains or filling only behind dikes constructed of erosion-resistant material.

2.3.2 Rationale - Turbidity

In extreme cases, turbidity has adverse effects on biota. The short-term levels of suspended sediment (which is one component of turbidity) required to adversely affect biota are higher than levels resulting from lakefilling. Localized levels of suspended solids above 25 mg/L (which is the generally accepted "no effect" level) may occur close to the active fill face; however, such levels are not expected beyond the immediate vicinity of the fill face.

At low levels, turbidity affects water uses such as bathing, industrial water uses and aesthetics. There are specific PWQOs/PWQGs to protect against adverse effects on these uses.

Studies indicate that turbidity increases due to lakefilling activities are usually difficult to discern over natural background levels, although violations of the PWQO/PWQG have been documented. These studies have been carried out in Lake Ontario in the Toronto area where background turbidity levels can be high, obscuring increases from lakefilling. In areas where background turbidity levels are low, violations of the PWQO/PWQG would be expected close to active lakefilling if loose soil is being dumped directly into the water.

2.3.3 Sedimentation Criteria

To minimize sediment losses, the mitigative measures outlined above to reduce turbidity will be required.

All sensitive water uses within the area where sedimentation is likely to occur will be protected. (The proponent will identify control measures prior to undertaking the project as well as remedial measures that will be taken if impacts do occur.)

2.3.4 Rationale - Sedimentation

Fill lost during the lakefilling process is likely to be deposited either along adjacent shorelines or offshore, and could affect navigation routes, water intakes and discharges, and aquatic habitat.

Deposition of fine-grained sediments and associated changes in benthic (bottom-dwelling biota) community structure have been documented in the vicinity of lakefills as a direct result of the loss of fill. In extreme cases, close to active filling, benthic communities are absent. Except in protected areas such as embayments and in small water bodies, deposited material will eventually be transported to deep parts of the lake.

3 REFERENCES

ONTARIO MINISTRY OF THE ENVIRONMENT (MOE) 1983. Handbook of Analytical Methods for Environmental Samples. Vol I and II. OMOE, Toronto.

ONTARIO MINISTRY OF ENVIRONMENT, 1984. Water Management - Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment, OMOE. Toronto, Ontario.

ONTARIO MINISTRY OF NATURAL RESOURCES, 1988. Wave Climate Database Catalogue, Conservation Authorities and Water Management Branch, Toronto, Ontario.

PERSAUD, D., R. JAAGUMAGI and A. HAYTON. 1992. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Toronto. 30pp.

Figure 1. Categorization Of Fill For Lakefilling

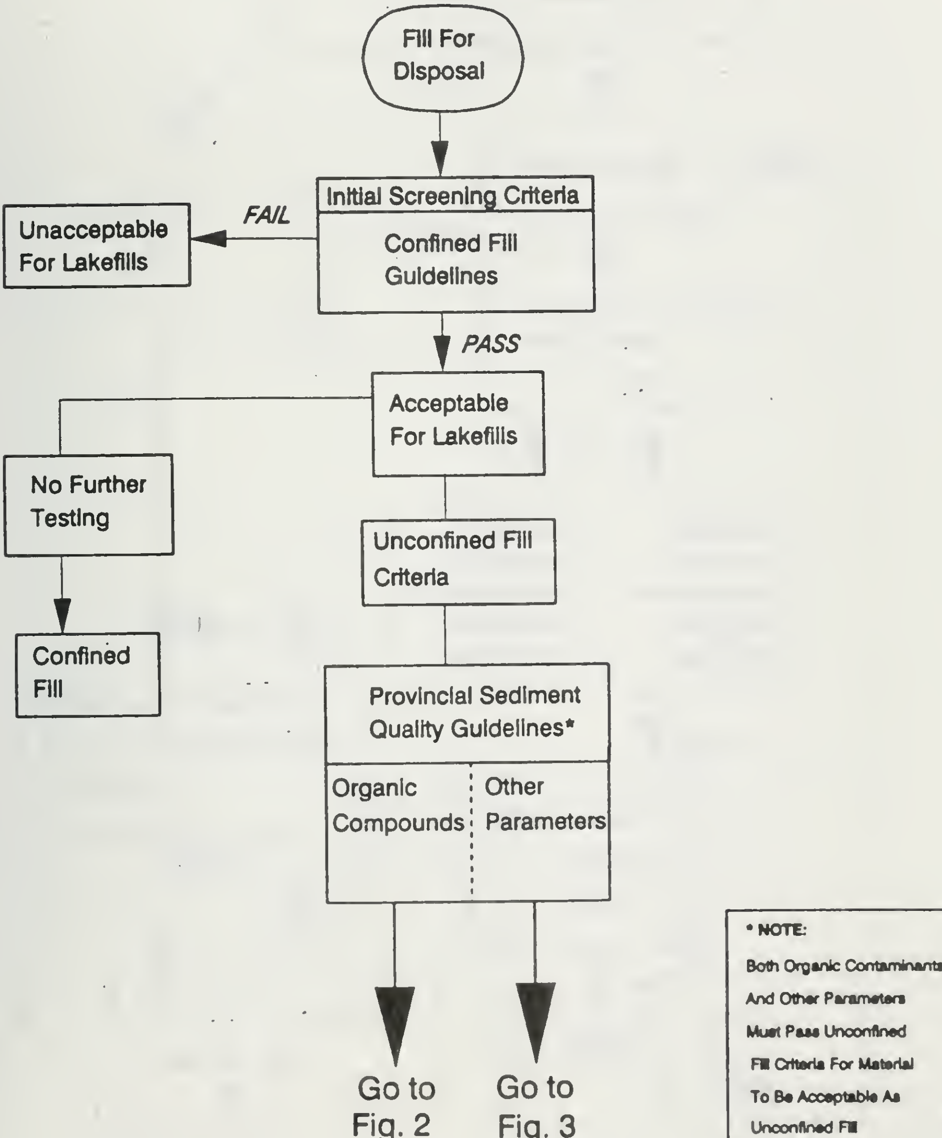


Figure 2. Site Specific Sediment Criteria For Organic Compounds

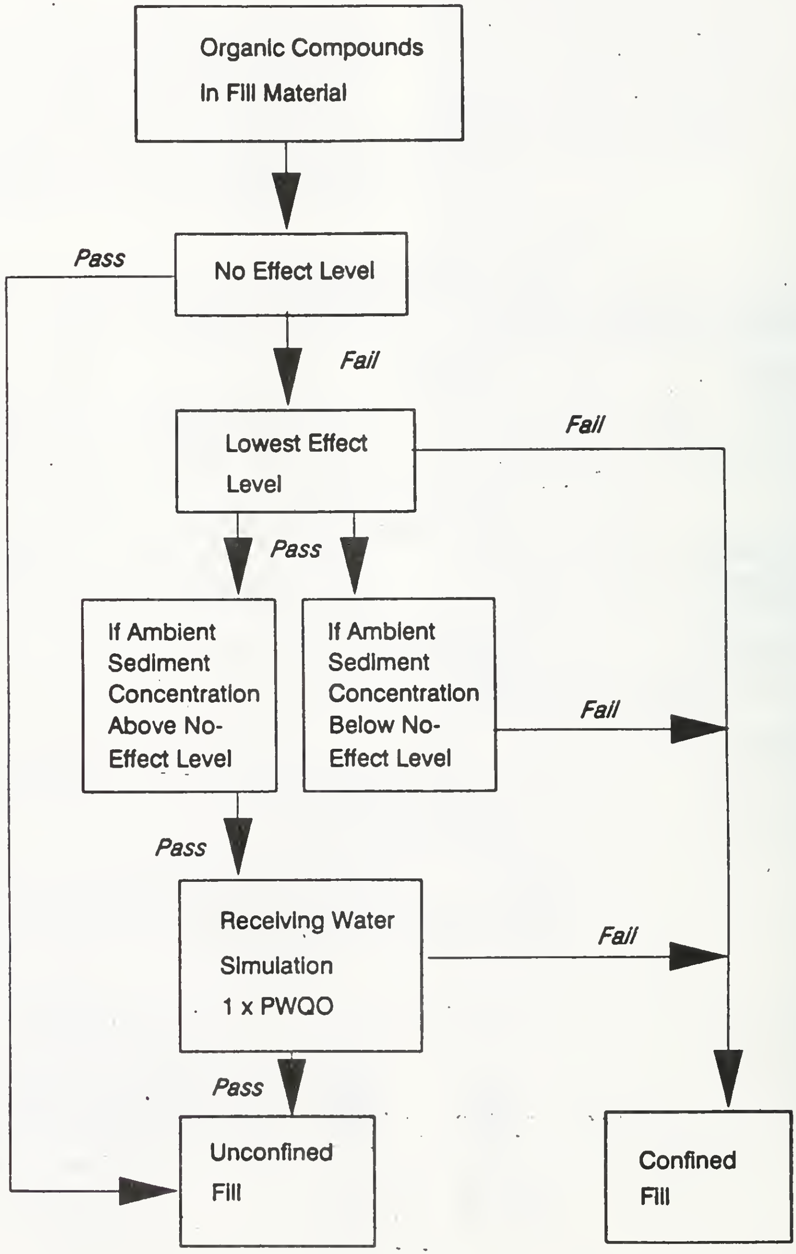
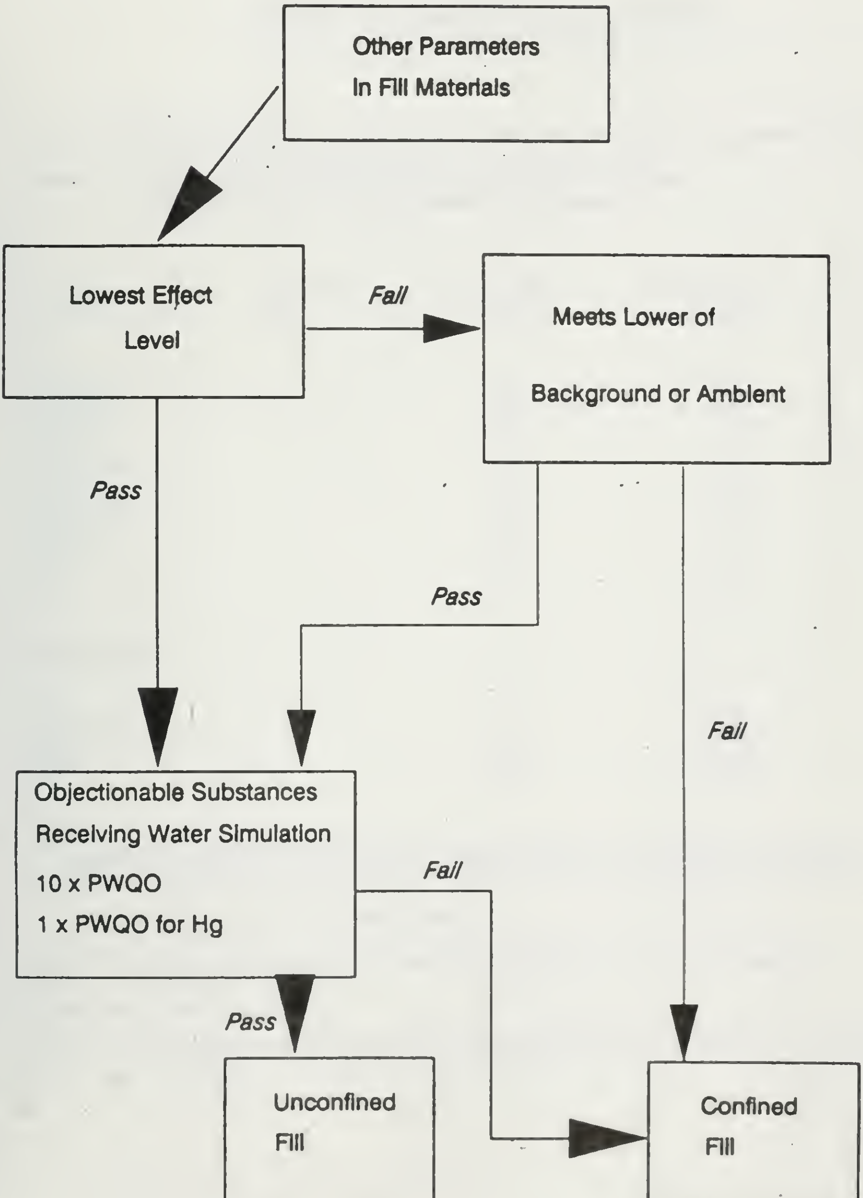


Figure 3. Site Specific Sediment Criteria For Other Parameters



APPENDIX A

PROVINCIAL SEDIMENT QUALITY GUIDELINES

Table 1: Provincial Sediment Quality Guidelines for Metals and Nutrients.
(values[a] in ug/g (ppm) dry weight unless otherwise noted)

METALS	No-Effect Level	Lowest Effect Level	Severe Effect Level
Arsenic	-	6	33
Cadmium	-	0.6	10
Chromium	-	26	110
Copper	-	16	110
Iron (%)	-	2	4
Lead	-	31	250
Manganese	-	460	1100
Mercury	-	0.2	2
Nickel	-	16	75
Zinc	-	120	820
NUTRIENTS			
TOC (%)	-	1	10
TKN	-	550	4800
TP	-	600	2000

[a] - values less than 10 have been rounded to 1 significant digit. Values greater than 10 have been rounded to two significant digits except for round numbers which remain unchanged (e.g., 400).

"-" - denotes insufficient data/no suitable method.

TOC - Total Organic Carbon TKN - Total Kjeldahl Nitrogen TP - Total Phosphorus

(Lakefill February 1992)

Table 2: Provincial Sediment Quality Guidelines for Organic Compounds.
(values[a] in µg/g (ppm) dry weight unless otherwise noted)

Compound	No Effect Level	Lowest Effect Level	Severe Effect Level (µg/g organic carbon)*
Aldrin	-	0.002	8
BHC	-	0.003	12
α-BHC	-	0.006	10
β-BHC	-	0.005	21
γ-BHC	0.0002	(0.003)[b]	(1)[c]
Chlordane	0.005	0.007	6
DDT(total)	-	0.007	12
op+pp-DDT	-	0.008	71
pp-DDD	-	0.008	6
pp-DDE	-	0.005	19
Dieldrin	0.0006	0.002	91
Endrin	0.0005	0.003	130
HCB	0.01	0.02	24
Heptachlor	0.0003	-	-
H epoxide	-	0.005[b]	5[c]
Mirex	-	0.007	130
PCB(total)	0.01	0.07	530
PCB 1254[d]	-	(0.06)[b]	(34)[c]
PCB 1248[d]	-	(0.03)[b]	(150)[c]
PCB 1016[d]	-	(0.007)[b]	(53)[c]
PCB 1260[d]	-	(0.005)[b]	(24)[c]
PAH (total)	-	(2)	(11,000)

Lowest Effect Levels and Severe Effect Levels are based on the 5th and 95th percentiles respectively of the Screening Level Concentration (SLC) (see Section 4.2.4) except where noted otherwise.

( ) Denotes tentative guidelines

[a] - Values less than 10 have been rounded to 1 significant digit. Values greater than 10 have been rounded to 2 significant digits except for round numbers which remain unchanged.

[b] - 10% SLC.

[c] - 90% SLC.

[d] - Analyses for PCB Arochlors are not mandatory unless specifically requested by MOE.

- Insufficient data to calculate guideline.

* Numbers in this column are to be converted to bulk sediment values by multiplying by the actual TOC concentration of the sediments (to a maximum of 10%), e.g. analysis of a sediment sample gave a PCB value of 30 ppm and a TOC of 5%. The value for PCB in the Severe Effects column is first converted to a bulk sediment value for a sediment with 5% TOC by multiplying 530 x 0.05 = 26.5 ppm as the Severe Effect Level guidelines for that sediment. The measured value of 30 ppm is then compared with this bulk sediment value and is found to exceed the guideline.

PAH (total) is the sum of 16 PAH compounds: Acenaphthene, Acenaphthylene, Anthracene, Benzo(k)fluoranthene, Benzo(b)fluorene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(g,h,i,)perylene, Chrysene, Dibenzo(a,h,)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3-cd)pyrene, Naphthalene, Phenanthrene and Pyrene.

(Lakefill February 1992)

APPENDIX B

Interim* Confined Fill Guidelines Mandatory Parameter List

Material of Residential/Agricultural Origin

PARAMETER	GUIDELINE ug/g
Antimony	0.43
Arsenic	11
Barium	160
Beryllium	1.1
Cadmium	0.7
Chromium VI	1
Chromium (total)	58
Cobalt	16
Copper	41
Lead	45
Mercury	0.2
Molybdenum	1
Nickel	38
Selenium	0.93
Silver	0.27
Vanadium	77
Zinc	120
Electrical Conductivity	0.36
Sodium Absorption Ratio	0.7
pH	3-10

PLUS: Any elements or compounds which an examination of the history of origins of the material indicate are likely to be of concern.

In addition, material that may be considered for use as Unconfined Fill should also be analysed for PCBs, Total Organic Carbon and Total Phosphorus. These analyses are not required if the material is being considered only as Confined Fill.

* These interim guidelines are adapted from the Proposed Policy for Management of Excess Soil, Rock and Like Materials. MOE May 1992 (draft) and define the upper limit of material that can be used in a lakefill.

Material of Industrial/Commercial Origin

PARAMETER	GUIDELINE (ug/g)
Inorganics	
As listed for Material of Residential/Agricultural Origin	
Volatile Organic Compounds	
Benzene	0.002
Toluene	0.002
Xylene (total)	0.002
Carbon tetrachloride	0.002
Trichloroethylene	0.004
Trichlorofluoromethane	0.012
Methylene chloride (dichloromethane)	0.003
Ethylene dichloride (1,2-dichloroethane)	0.002
1,1,1-trichloroethane	0.005
Tetrachloroethylene	0.002
Polychlorinated Biphenyls	
PCBs	0.3
Polycyclic Aromatic Hydrocarbons	
Benzo(a)pyrene	0.05
Dibenz(a,h)anthracene	0.1
Benzo(a)anthracene	0.05
Benzo(g,h,i)perylene	0.1
Fluoranthene	0.14
Phenanthrene	0.092
Naphthalene	0.05
Pyrene	0.11
Phenols	
2,4,6-trichlorophenol	0.1
2,4-dichlorophenol	0.1
p-cresol	0.1
pentachlorophenol	0.1
Plus	

Any elements or compounds, which an examination of the history of origins of the material indicate, are likely to be of concern.

APPENDIX C

APPLICATION CONSIDERATIONS FOR LAKEFILL GUIDELINES

Formal application procedures for lakefilling are to be developed as part of the comprehensive Lakefill Policy. On an interim basis, the strategy outlined below has been developed based on existing procedures.

Types of Projects

The fill quality guidelines apply to all new and on-going lakefill projects (on-going projects may be reviewed on a case-by-case basis and exemptions may be granted by the regional Director if the proponent can demonstrate that no adverse effects are likely to result from such an exemption) including:

- shoreline stabilization projects
- construction of piers, groynes, docks, and causeways
- construction of breakwaters and Confined Disposal Facility (CDF) perimeter walls/structures
- large-scale projects for recreational purposes (e.g., Bluffers Park)
- beach creation
- enclosure dykes or dams for mine tailings ponds.

Lakefill fill quality guidelines do not apply to:

- material placed within a CDF structure such as dredge spoils and mine tailings. These are granted approval under Part V of the E.P. Act and conditions of disposal will be regulated through Certificates of Approval since these structures are designed to contain specific materials for disposal
- material placed on shorelands above the high water mark and adequately stabilized or protected
- filling behind impermeable barriers such as concrete or sheetpile revetment walls (subject to appropriate treatment of decant water).

Projects exempted from the Fill Quality Guidelines

- projects designated as emergency shoreline works (designated by a regional Director), e.g., repairs and maintenance to flood and beach protection works.

Project Specific Application Procedures

Large Scale Projects Subject to the Environmental Assessment (E.A.) Act: All projects subject to the Environmental Assessment (E.A.) Act (either Full E.A. or Class E.A.) would typically proceed through the Environmental Assessment process and the Guidelines would be applied through conditions written into the Terms and Conditions of Approval of the project. In the case of Class E.A.s, this information would be contained in the Environmental Study Report of individual projects. It is expected that when Class E.A.s having lakefilling components come up for review they will specifically address and comply with the Lakefill Policy. It should be noted that Lakefill projects are not waste disposal facilities and as such would not come under Part V of the E.P. Act and would not require a Certificate of Approval.

Fill quality guidelines and other design and construction mitigation measures as may be required as part of fulfilling the E.A. Act would be established as specific conditions and procedures to be used in the E.A. process. This would require the proponent to provide details in the initial E. A. document of how lakefilling would be done and what environmental safeguards would be followed. These would then become part of the conditions of approval of the E.A.

Large-scale Projects not designated under and/or exempted from the E.A. Act.
Proponents of projects exempted from the E.A. Process are not exempted from any of the guidelines or other policies related to lakefilling and are required to provide to the MOE Regional Director all information on fill quality and construction techniques (i.e. engineering design) that would normally have been required for E.A. Approval. In addition the proponent should ensure that the project is not in contravention of any other Federal or Provincial statutes.

Federal Projects (CDFs, Small Craft Harbours): All Federal projects are exempt from Provincial legislation. In the past, the Federal government, through Environment Canada, has been willing to impose Provincial guidelines/policies on federal projects. The province expect this level of cooperation will continue under the new guidelines.

Small-scale Provincial and Private: most small-scale projects would require a Ministry of Natural Resources (MNR) Work Permit. The MNR work permit system is operated under the Public Lands Act and provides that no person shall dredge or fill a shoreland or work on any public land without a work permit. MNR permits give consideration to fisheries concerns (Fisheries Act) and projects that could alter or destroy fish habitat would normally not be granted a work permit.

MOE comments on projects under the MNR permitting system. This is currently done on an informal basis but allows MOE Districts and/or Region to review and comment on all small scale lakefilling projects. The proponent initially applies for approval through the Public Lands Act. The proponent is then instructed to contact the MOE District Office. Currently most of the projects submitted for approval have a perimeter constructed of clean material (granular, rock, sheet piles) prior to backfilling with fine material. For larger projects, the proponent often identifies the source of the backfill material "borrow area".

General Conditions Governing Fill Evaluation

a) Certain types of material are considered acceptable for lakefilling. These include concrete rubble, as well as sand, gravel and excavated soils. Some materials, such as asphalt and construction debris, are not considered acceptable for use in contact with open water, though such material may be considered for use where the proponent is able to demonstrate, through studies funded by the proponent, that the material will not adversely affect the aquatic environment.

b) Classification criteria for fill have been developed in conjunction with Materials Management Policy. A single series of analytical tests are required for material classification. Material will be tested by bulk sediment analysis and results reported on a dry weight basis (see *Sampling and Analytical Protocols* in the Proposed Policy for Management of Excess Soil, Rock and Like Materials for sampling procedures). According to the results of these tests, material classified as Inert Fill (Proposed Policy for Management of Excess Soils, Sediments and Like Materials) can then be placed in a lakefill. No additional testing is required at this stage if the material is destined only for use as Confined Fill.

c) Material that passes additional tests as outlined in this document can qualify as Unconfined Fill and can be placed in contact with open water. In order for material to be classified as Unconfined Fill, it must pass the Provincial Sediment Quality Guidelines criteria, which will not require additional testing to the bulk test referred to above, as well as a Receiving Water Simulation test, which will require additional testing.

The testing requirements, such as minimum number of samples, site history, etc. are detailed in the *Sampling and Analytical Protocols* developed as part of the Proposed Policy for Management of Excess Soil, Rock and Like Materials. As a minimum, analysis will include all parameters identified in Table 1. Additional parameters may be required by MOE regional offices on a case-by-case basis, depending on site history.

General Conditions Governing Fill Placement

- filling should only take place during a defined calm period (i.e., June to August or MNR Hindcast Method) in those areas subject to storm/wave damage.
- exposed fill face should not be more than a specified length, usually 15 metres.
- in instances where Confined Fill will be used in a lakefill, the outer structure must be constructed of material meeting the Unconfined Fill criteria (e.g., quarry stone, concrete rubble, or other similarly inert material (as per Policy for Management of Excess Soils, Sediments and Like Materials). The outer structure must be completed to provide full protection before commencing placement of material classified as Confined Fill.

Siting and Design Considerations

The following general provisions must be given full consideration during the siting and design phase to ensure a lakefill will not affect water uses.

Lakefills:

- should be located so as not to affect water intakes or outfalls.
- should be located so as not to affect navigation routes or shipping channels.
- should be located such that erosion of material will not affect the structural or functional integrity of onshore and offshore discharges or intakes or other sensitive water uses.
- should be designed to minimize the creation of embayment areas, minimize the amount of semi-protected shoreline created, maximize the flushing of embayments reducing the deposition of sediments, so as to avoid direct input of storm sewers or other discharges into embayments created.

THE ONTARIO GOVERNMENT'S PLANS FOR THE PROMOTION OF GREEN INDUSTRY

by
George Davies, Deputy Minister, Ministry of Energy, Toronto, Ontario

This annual Ontario Conference on the Environment provides an excellent forum for industry and government to share ideas and perspectives. It's a real pleasure to take part in this opening session.

I'm especially pleased to be taking part in a conference sponsored by the Ministry of the Environment. Our two ministries -- Energy and Environment -- are close partners in the effort to put Ontario firmly on the path to sustainable development and a greener future.

I wish that spirit of partnership were a little more widespread. In a recent book, economist Lester Thurow of the Massachusetts Institute of Technology reflected on why economists and environmentalists don't get along. To the economist, Thurow says, goods and services are the primary focus -- and a clean environment is only one of many desirable economic outputs.

But to the environmentalist -- Thurow says -- goods and services are distinctly secondary, and "a green environment is worth more than green money." Or money of any colour, he might have added.

Thurow feels it's time the two groups signed a peace treaty. We in the Ontario government agree.

We are now working on a Green Industry Strategy that will bridge the concerns of economists and environmentalists. We realize that a decent environment is a vital part of our quality of life, and that making our economy more conserving will ultimately be a source of strength and competitive advantage.

But what is a green industry, anyway?

There are two meanings. In a general sense, a green industry -- with a small "g" and a small "i" -- could be any industry. Industries become green by minimizing the environmental impact of everything they do.

But Green Industry -- with a capital "G" and a capital "I" -- has a narrower focus. It refers to companies that make products, operate processes or provide services that help protect or improve the environment. These companies supply the technology, goods and services needed for energy efficiency, water conservation, pollution prevention, and the 3 Rs.

Ontario's emerging strategy covers industrial greening in both senses.

What makes industrial greening so important is the link with innovation. In all advanced nations today, innovation is viewed as the key to competitiveness and future prosperity. The Ontario government puts innovation at the heart of its economic policy.

The rewards for innovation -- for being first through the door with new technologies, services or products -- can be enormous. The leaders can gain a substantial marketing advantage and a highly competitive economy.

Environmental awareness is now a force -- perhaps the most potent force -- driving innovation.

Michael Porter, in his study for the Business Council on National Issues, highlighted four factors that spark innovation: changing government regulations ... changing consumer demand ... changing input prices ... and changing technologies and processes.

The environment is at the cutting edge of all four trends. Whether it's clean air regulations or acid rain controls ... consumer demand for recycled paper and environmentally friendly packaging ... outright bans on some inputs like DDT and CFCs ... shifting prices for energy, land and water ... or the auto industry's quest for low-emission vehicles -- in all these areas environmental concerns are the catalyst.

In a wide spectrum of industries, innovation, research and development are now heavily driven by the environment. Any company that resists the environmental trend is fighting powerful market and economic forces -- forces that are laden with opportunity.

If we fail to respond quickly to the environmental challenge, we'll enter a downward spiral. The clean-up costs will consume vast amounts of money, leaving few dollars to invest in treating the underlying causes. Both the economy and the environment will get worse and worse.

But if we can rapidly make the transition to a more environmentally friendly economy, we can start a virtuous rather than a vicious cycle.

The key will be a new approach to environmental protection. Our traditional practice has been to catch pollutants as they leave the process -- "at the end of the pipe." Most companies have conducted business as usual, with environmental protection as an add-on.

But this approach has proven expensive and frustrating for business, and has generally achieved a limited reduction in emissions and effluents. Often we've just turned one form of pollution into another. Capturing liquid effluents, for example, can leave solid waste, and burning solid waste creates air pollution.

It makes more sense to return to the front end of the pipe -- to shift our focus from the waste outlet to the laboratory. We need to rethink our products and our industrial processes from the very start. We need to build in energy efficiency and pollution prevention at the R&D, engineering and design stages.

Zero discharge should be our goal. The route to this ideal state is to minimize waste -- by capturing the value contained in all the material going through a plant.

A growing number of companies in the petrochemical and other industries recognize this and are now working on closed-loop processes that allow no effluent to escape into the environment.

It's a totally new approach to industrial design that involves rethinking and redesigning processes from first principles. It's a major challenge for Ontario industry -- but it's one that will produce better products and make for more competitive companies.

Now let me turn to one of my favourite subjects -- energy efficiency.

Energy efficiency is a leading example of the convergence of economic and environmental goals. It can be much less costly -- in dollar terms -- to save energy than to keep producing it. And it's also much easier on the environment.

Consider electricity, for example. Ontario Hydro calculates that energy-efficient home appliances can reduce electricity consumption for a remarkably low cost -- ranging from less than 1 cent to 2.2 cents per kilowatt hour saved over the life of the appliance.

By not having to produce that power, Hydro avoids much greater costs, ranging from 4 to 7 cents per kilowatt hour. Numbers like that explain why demand management is so attractive.

An important point about demand management is that, when it lowers peak demand, it reduces the need to build large new generating facilities. By the end of the decade, Hydro expects to achieve electricity savings of around 5,200 megawatts. This is equivalent to the output of one and a half Darlington-sized nuclear stations.

Hydro expects that another Darlington would cost upwards of $20 billion. Through demand management, Hydro and its ratepayers can avoid the mega-costs and the mega-risks involved in massive supply investments.

And if we can contain the need for electricity, it will help us to address a host of environmental problems -- from nuclear waste, acid rain, smog and global warming, to the ecological impact of new hydroelectric dams.

Similar thinking applies to our water and sewer infrastructure in this province. Projected capital spending for system upgrades alone totals $7 to $17 billion over the next 15 years, and proposed capacity expansions go far beyond this.

We simply can't afford this level of capital expenditure if there are cheaper alternatives. A case can be made for demand management for water, similar to that for electricity.

Enormous opportunities exist to save money and help save the environment at the same time.

For example, water use in one-third of the province is not metered -- which means its use is not measured and charged for. Metering would be a major step forward in controlling utilization.

And it's been shown that simple measures like low-flow showerheads and toilets can slash household water consumption by 40 per cent, with a payback period of just one to two years.

Audits in the industrial, commercial and institutional sectors report similar findings: a 20 to 40 per cent water reduction easily achieved, with a one to three year payback.

This makes a strong case for water efficiency when you compare these paybacks to paybacks of 20 to 30 years for new water and sewer systems.

But the time for merely talking about such things is past. Action is urgent, because he or she who hesitates is -- broke. We have to move quickly to develop our green industry in order to play our part in the massive market that is developing internationally for green products and services.

According to data collected by the U.S. Commerce Department, the world market for pollution control products and environmental services reached $370 billion last year.

In the U.S. itself, it's estimated that between 65,000 and 75,000 environmental companies achieved sales of $130 billion last year. And the industry is growing between 8 and 18 per cent a year.

Ontario's Green Industry at present includes some 1,800 companies, recording more than $2 billion in annual sales and employing 28,000 people.

The industrial and consumer market for green products is hard to compute -- but our best guess is that it could reach 3.5 per cent of GDP, or $10 billion in Ontario this year.

The Ontario government intends to accelerate the growth of this green market so as to create an economy -- and a society -- that are environmentally sustainable. At the same time, we want to keep the economic benefits of supplying this new market within the province, as far as economically feasible. Our goal is to see a large share of this green demand met by competitive Ontario firms with export potential.

The Green Industry Strategy is a key part of the government's economic renewal plan. It is being developed in collaboration with business, environmental, and other groups, and with the support of seven government ministries.

Our strategy has two overriding goals:

- o to encourage the growth of the market for green products and services, and
- o to help Ontario companies gear up to meet this market demand.

The challenge for all Ontario industries is to get out there on the crest of the environmental wave. Government's role is to put in place the pieces that will facilitate the greening of the economy and the growth of Green industry.

To help build the market for green products and services, we plan to pilot the concept of community-based Green Teams to lead a household green audit and retrofit program. This new concept will test one-stop shopping for the consumer by coordination of audits for energy, water and waste.

We are currently talking to a few municipalities that could both benefit from this approach and help us to demonstrate it.

Green Teams could offer information and advice on efficient light bulbs, refrigerators, showerheads, toilets, composters and so forth. We would like to see if they could be run as a collaborative effort involving local utilities, tradespeople, retailers, trainers and environmental groups.

We are counting on partnership and co-operation by the local players to mobilize communities behind this promising new initiative.

We are also working on a co-ordinated approach to efficiency initiatives for industry.

Here, it makes sense to consider changes to industrial processes that look at use of, and impact on, resources -- energy, air, water and soil -- in a coordinated fashion. We can work with these companies in their efforts to become more environmentally friendly, and at the same time more competitive.

Through such activities we expect to expand the green market significantly. But to supply this emerging market, we'll need a whole new generation of highly engineered, environmentally friendly products.

That's where our supplier development initiatives come in. We want Ontario to become a leading producer and exporter of environmental goods and services. The ministries involved are working together to remove barriers, seek and encourage stakeholder involvement.

Our tactics in the short run are to identify new product opportunities and go after them. We now have a list of more than 200 such opportunities, and are currently concentrating on the top dozen.

For example, we're working with two Ontario-based companies that want to produce low-flow toilets for use in new construction and for the retrofit market.

The General Electric lighting project, announced in January, is another example of our strategy in action. With government support, General Electric Canada is investing $144 million at its Oakville plant to produce two of the three most advanced energy-efficient lighting products in the world -- the T-8 fluorescent lamp and the Halogen-IR lamp.

Over the longer term, a Business Development Unit recently established by Ontario Hydro will play a pivotal role in the Green Industry strategy. This unit operates in conjunction with the Ministry of Energy and the Ministry of Industry, Trade and Technology.

Hydro plans to invest $6 billion in demand management by the year 2000 -- a commitment expected to lever an additional $10-15 billion in spending by the private sector. Hydro's new unit has a mission to develop suppliers of energy-efficient products, so Hydro can reach its demand management targets while securing the industrial benefits for Ontario.

In the past, Hydro has worked with the nuclear industry and makers of transmission and generating equipment to meet the requirements of the supply side of the utility system. As a result of this cooperation, Ontario companies provide more than 75 per cent of Ontario Hydro's purchases.

Now the challenge is to develop internationally competitive firms to serve the demand side. We hope to produce energy-efficient lighting, refrigerators, motors, lighting ballasts and so forth -- not only for the Ontario market -- but for the world market as well.

The new Hydro Business Development unit will have strong links with the household and industrial conservation initiatives, and in general with the suppliers and users of green products. Its role is to improve the flow of information -- to tell users about new environmentally friendly products and services, and to tell suppliers what users want.

Of course, our market development and supplier development initiatives both depend on money. That isn't easy to find these days, as no one needs to be reminded. But in this particular case, the risks are greatly reduced by high regulatory standards, product-testing and access to predictable markets.

We are confident the capital sources will be there to finance the greening of Ontario industry and the development of new green products and services.

Let me reiterate that Ontario's Green Industry Strategy supports both economic and environmental goals.

o It promotes economic renewal through innovation and the creation of high-value-added jobs.

o It will reduce public sector infrastructure costs -- for power plants, water treatment facilities and landfill sites.

- And it will moderate demands on the environment and help ensure that our children inherit a livable planet.

The success of the Green Industry Strategy will depend on new partnerships -- across government, across communities and across industries -- and between industries, communities and government.

Together, we can move Ontario toward a sustainable future. And by example, we can help achieve a sustainable world. Thank you.

ECONOMIC RENEWAL STRATEGIES AND LAND USE PLANNING REFORM

by
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Ontario

Good planning is visionary. It is mindful of the past, respectful of tradition and forward looking. Good planning is value centred, based on sound principles that reflect who we are as a community and what we want to become. The planning decisions we make today will affect our communities for generations to come.

The strategic vision that a community creates holds the key to its future. Land use planning is an integral component of such a strategic plan and a tool to assist local governments achieve the future their community needs and desires.

Good land use planning is environmentally sound, socially and culturally sensitive and economically viable.

The Province has an obligation as well as an interest in the quality of local land use planning. The rules and regulations established by the Province set the parameters within which municipal governments plan their communities. An essential element in the planning process must be the protection and improvement of environmental quality. We cannot take the environment for granted in planning growth and this requires us to better understand the full effects of our activities on our natural surroundings. Over the long term the maintenance of open, undeveloped spaces, environmentally sensitive features, and biological diversity will result in healthy, sustainable communities.

We must, in planning for our communities, recognize social needs by ensuring access to the full range of resources, such as housing, places of employment, open space, recreation, education, and health facilities. Land use planning must support the maintenance and development of healthy and safe communities with adequate physical and social environments for their residents.

Planning for a community must continue to support economic activity by encouraging economic opportunities. Our communities will continue to grow - we will need new jobs and continued economic support for the existing businesses and industries. We will need fully serviced land capable of attracting new business and industry.

LAND USE PLANNING REFORM

In June of 1991, Dave Cooke, the Minister of Municipal Affairs, announced the creation of the "Commission for Planning and Development Reform in Ontario", chaired by John Sewell. As part of its mandate the Sewell Commission has been asked to recommend changes to the land use planning process that will ensure the planning process is open, fair, accountable and effective in serving the public interest and will support provincial priorities in environmental protection. The Sewell Commission is seeking public input through extensive consultations, in the form of public hearings and written submissions and expects to present its recommendations early in '93.

PROVINCIAL PLANNING

The ministry is building the capacity to strategically manage and develop broad provincial policy initiatives that relate to the effective and efficient delivery of provincial services for community economic development and growth of regions, municipalities and rural areas. This means taking a broad, long term view of the province through strategic planning and inter-ministry co-ordination.

In the area just beyond the boundaries of the Greater Toronto Area, the first strides are being made to identify and address issues of growth and development that extend beyond the boundaries of individual municipalities, regions or counties. This work has highlighted the importance of linking environmental planning for watersheds and headwaters with the settlement and servicing plans of communities that share the watershed. We think it will point the way toward the development of provincial strategies tailored to different regions of the province.

ECONOMIC RENEWAL STRATEGIES

Ontario has been dealt a serious blow by the recession. All areas of the Province have been affected, but it is in the urban centres where 70 per cent of Ontario's employment is located that the impact of the recession has been felt the most: 72 per cent of Ontario's unemployed live in major urban centres. 72,000 construction jobs were lost in 1991, representing 21 per cent of the construction labour force.

Residential and commercial construction is widely recognized as a significant key to economic recovery. The current regulatory system is not well equipped to respond quickly to development projects, private or public, that have the potential to stimulate and sustain the economy and create jobs.

For the long term, the Sewell Commission will be making recommendations for improvements to the land use planning process. In the meantime, however, there are short term steps that we can take immediately to make the current planning and regulatory system work better. The current system of planning approvals in Ontario has evolved over the years, through decades of unprecedented growth in Ontario. It is a complex system with many layers of review by various government agencies. Labour, business and the municipal sector have lost faith in the development approvals process. They view it as a deterrent to growth and economic recovery because of the length of time and high cost of complying with government requirements before approvals are given.

On April 9, 1992, the Minister of Municipal Affairs made a statement to the Legislature in which he outlined plans to speed up the Provincial land use planning decision-making process. "Supporting Urban Economic Recovery" is a package of Government initiatives designed to effectively manage provincial planning decisions to provide opportunities for new construction and development, while maintaining environmental and other standards. We need a quicker, smarter way to determine whether or not a development project should be approved or not.

Interministerial teams have been organized on a geographical basis around the Province. They are small teams of planners from the ministries that are actively involved in reviewing, commenting and making decisions on development applications: Ministries of Municipal Affairs, Environment, Natural Resources, Agriculture and Food, Transportation, Housing and Culture and Communications.

These Core Teams, led by Municipal Affairs, will provide a corporate plan review service and develop criteria and process for streamlined decision-making. There will be priorities set for provincial decisions based on good planning, protection of the environment and creating jobs. The Core Teams will prepare coordinated provincial positions on new official plans and updates and will identify specific major, complex projects for accelerated decision-making.

The Core Teams are located in 8 regions throughout the Province with equal opportunity to accelerate decisions on identified priority projects in those regions. By preparing coordinated provincial positions on new official plans they will be enabling all regions in the Province to prepare for new projects now and in the future.

While many of the priority projects will be located in large urban centres such as the Palladium in Ottawa-Carleton, many of the projects will be in small urban areas located within rural Ontario. The economic benefits derived will benefit the whole province.

Ministries will be working together in this initiative, as a team. Individually, as in the case of the Ministry of the Environment, each ministry is committed to speeding up its own turnaround time. Together they will make faster decisions so that good projects that meet all of the provincial requirements and standards of good planning are not delayed.

Accelerating decision-making does not mean we have abandoned our environmental responsibilities. On the contrary. The principles of good planning, which include environmental safeguards, will continue to be the foundation of every land use decision. Nor does accelerating the decision-making process mean that every project will be approved. What it does mean is that a <u>decision</u> will be made faster, even when the decision is "NO".

All Ministries with plan review responsibilities will produce guidelines setting out standards and approval requirements for official plans and projects to provide more certainty in the process for proponents, reviewers and the public. The Ministry of Municipal Affairs will soon release Streamlining Guidelines for all involved in the planning process to assist in making the system more efficient and will also outline policies and good planning principles to be reflected in new official plans.

We estimate that somewhere in the order of 200 new official plans and major official plan amendments will proceed before the work of the Sewell Commission has been completed. In anticipation of Sewell's recommendations we are developing Guidelines on Growth and Settlement Policy that represent current thinking and existing practice and that are "in tune" with the direction that the Sewell Commission is taking. Obviously, planning and development will continue as the Commission's work proceeds.

The manner in which growth is accommodated and the resulting land use patterns can have profound economic, environmental and social effects that are felt both within and beyond the local municipality. The province has an obligation, as do the other levels of government, to do its part in ensuring that effective land use planning is carried out using the best information available. By preparing and releasing guidelines now on planning for growth, we will be able to apply them to new plans and proposals while the Commission completes its mandate and its recommendations are implemented.

Land use planning and economic renewal are interdependent. All land use planning must be founded in good planning principles which include economic viability. Economic recovery can be stimulated by making good land use decisions that ensure that environmentally sound development and construction projects can come on stream quickly.

LAKE ONTARIO GREENWAY STRATEGY

by

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and Suzanne Barrett, Director of Environmental Studies, Royal Commission on the Future of the Toronto Waterfront, Toronto, Ontario

REGENERATION

The final report of the Crombie Commission: "*Regeneration - Toronto's Waterfront and the Sustainable City*", was released on May 14 1992. It summarises three-and-a-half years of studies and recommendations by the Commission. The report highlights the links that exist between city and nature -- among people, the economy, health, and environmental sustainability. It promotes the ecosystem approach to achieve regeneration of both the environment and the economy.

Regeneration is defined as a process that restores and maintains environmental health, as well as anticipating and preventing future harm. This means striving to ensure that existing land uses and activities are adapted, and all new development is designed, to contribute to the health, diversity, and sustainability of the entire ecosystem: the physical environment, human communities, and economic activities.

The Province, recognising the importance of acting on the recommendations of the Crombie Commission, has taken steps to establish a Waterfront Regeneration Trust. This agency will coordinate the regeneration of the Lake Ontario Waterfront from Burlington Bay, in the west, to the Trent River, in the east. It will:

- champion the ecological integrity of the watefront;
- identify and protect the public's interest in the waterfront based on the principles of clean, green, useable, diverse, open, accessible, connected, affordable and attractive; and
- work with all levels of government, agencies, community groups and other interests, including the private sector, to meet common goals compatible with job creation, economic development, and a healthy, accessible waterfront.

LAKE ONTARIO GREENWAY STRATEGY

One of the projects Minister Grier has asked the Waterfront Regeneration Trust to undertake is a Lake Ontario Greenway Strategy. The primary objective of this Greenway Strategy is to ensure that waterfront activities and development contribute to ecosystem health by protecting natural and cultural heritage, remediating problem areas and systems, and enhancing opportunities for recreation and economic activities. It will provide an integrated approach to implementing a number of recommendations in *Regeneration*, particularly those regarding the Waterfront Trail and other recreation opportunities, protecting vistas, shoreline management, habitat protection and restoration, soil remediation, dealing with polluted water and sediments, and ecosystem-based planning.

A greenway along the waterfront will achieve many benefits. It will:

- provide recreation opportunities close to home;
- connect ecological systems and habitats;
- enhance water quality;
- provide opportunities for economic activities;
- contribute to liveable communities; and
- involve residents in regeneration projects.

Shoreline Management. The shoreline management component of the Greenway Strategy will continue work already undertaken by the Commission and published in discussion paper #13: "*Shoreline Regeneration for the Greater Toronto Bioregion*". This study examined the policies, practices, technology and methods available for shoreline regeneration, including lakefilling, erosion protection, and fishery management. It identified a number of benefits of shoreline management, as well as a number of issues. The benefits include protection of waterfront facilities from erosion, and the provision of new waterfront land for recreation and other uses. Some of the key issues include a lack of attention to cumulative effects; impacts on habitats, water quality, sediment quality and coastal processes; limitations of existing standards and controls; and effects on vistas and public access to the waterfront.

The Shoreline Regeneration study concluded that there is a need for integrated planning and management of the shoreline, to provide coordination of the many agencies and other interests involved, establish shared goals, facilitate balanced decisions, and stimulate appropriate action. The Lake Ontario Greenway Strategy is intended to achieve this and will include:

- descriptive maps showing key habitat and coastal process information;
- assessment of physical processes and habitat for sections of the shore with recommendations for management;
- criteria and conditions for lakefilling and erosion control; and
- policy development.

Process for the Greenway Strategy. The Waterfront Regeneration Trust will act as a facilitator and a catalyst to achieve the objectives of the Greenway Strategy. It will work collaboratively with all levels of government, the business sector, non-government groups, and the general public. Mr Crombie will chair a steering committee with broad representation. Workgroups will be established to undertake specific aspects of the strategy, and the results of their work will be integrated to form the Strategy. Initial public consultation will be held this fall, and continued during the preparation of the Strategy. The target date for completion of the draft strategy is June 1994, although projects that are consistent with the emerging strategy will be encouraged and implemented before that time.

Implementation of the Greenway Strategy. A number of mechanisms will be used to implement the Strategy. They include:

- the development of Provincial policies, standards and guidelines;
- integration of policies and projects into municipal and conservation authority plans; and
- waterfront partnership agreements.

Moderator: Peter Victor, Assistant Deputy Minister, Policy Development & Intergovernmental Relations, Environment Ontario, Toronto

David Reid, Environmental Protection Industries Sector, Domestic Industry Support Branch, Ministry of Industry, Trade and Technology, Toronto, Ontario

Donald A. Hames, Dow Chemical Inc. Sarnia, Ontario

Wayne Wright, Vice-President, Canadian Petroleum Products Institute, Willowdale, Ontario

Ian Tedford, Manager, Environmental Programs, Xerox Canada Ltd. North York, Ontario

Rose Todorski, Facilities Management, Bell Canada Etobicoke, Ontario

Dave Burman, Facilities Management, Bell Canada Etobicoke, Ontario

Opportunities in Waste Management

Highlights of a Presentation to the 39th Ontario Conference on the Environment, June 15, 1992, Prince Hotel, Toronto

Presented by: David Reid
Domestic Industry Support Branch
Ontario Ministry of Industry, Trade and Technology
Toronto, Ontario

Opportunities in Waste Management
To Be Covered

- MITT and the Domestic Industry Support Branch
- The Problem and The Opportunity in Waste Management (Energy, Water, Solid Waste)
- Markets and Growth Rates
- Strategic Alliance Opportunities
- Possible Strategic Alliance Partners
- The Environmental Protection Industry
- Some Problems/Opportunities Waiting to be "Discovered"
- Ontario Industrial Strategy Framework

Opportunities in Waste Management

Ontario Ministry of Industry, Trade and Technology

Mandate:	To Assist in Improving the Competitiveness of Ontario Industry in Both Tradeable Goods and Services
Offices:	18 in Ontario 15 International including 6 in the United States
Domestic Industry Support Branch:	9 Sector Consultants covering 12 Sectors including environmental industries

The Problem and the Opportunity

Municipal and ICI waste generated annually (million tonnes*):

GTA	2.4	(ICI, 1990)
Ontario	10.0	(50-60% ICI)
Canada	30.0	
United States	255.0	(1991)

Decrease in U.S. solid waste generation was only 11 million tonnes, (4% reduction) over 1990. The waste to landfill decrease was only 1%. Recycling of solid waste grew from under 9% in 1989 to 14% in 1991 (BioCycle, April '92). Significant opportunities still exist for both source reduction and recycling/remanufacturing. Ontario targets are 25% diversion of waste by the end of 1992 and 50% by the year 2000.

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* Figures (1990/1991) are approximate.
Designation of Construction/Demolition waste between ICI/municipal sector varies by city/province/country.

The Problem and the Opportunity
Water Consumption

Existing Residential Water Consumption (litres/day/per cap*):

Ontario	300
Canada	360
United States	426
Germany	150
Israel	135

Estimated possible Ontario residential water consumption savings 40% or more from water saving devices.

1989 Ontario Water Use by Sector (%*):

Power Generation	79.9
Mining/Manufacturing	13.6
Municipal	6.1
Agriculture	0.4

1989 Approximate International Municipal Water Rates (cents/cu.M)

Canada	$ .38
Ontario	$ .79 (Combined water/wastewater change where metered)
Germany	$ 1.38

* Sources: MNR 1989; Environment Canada; Tate, Water Demand Management in Canada, 1983, National Utility Service, 1989.

The Problem and The Opportunity

Energy Consumption

Approximate Energy Consumption Per Unit of Gross Domestic Product
(tons of oil equivalent per $1,000 GDP)

	1986	1973
Ontario	0.45	0.58
Canada	0.48	0.62
USA	0.40	0.58
Germany	0.34	0.42
Japan	0.30	0.36

United States consumption is 86% of Canada's, Germany's 72% and Japan's 47%. Ontario has approximately 36% of the national population and 41% of the GDP.

Source: Ministry of Energy, Ontario Energy Review 4th Edition, 1990

Growth Opportunities

Areas of Traditional Waste Management Goods and Services:

- Haulage
- Landfill Disposal
- Hazardous Waste Treatment/Storage
- Recycling (Blue Box Materials)

Emerging Waste Management Issues and Opportunities:

- Waste and liability audits
- Remanufacturing (e.g. Domal Envirotech, rubber manhole doughnut)
- Market development (recycled materials e.g. production process by-products)
- Ozone depletion protection (e.g. Halozone, Blue Bottle)
- Air and water emissions control through process design (e.g. closed loop production systems)
- Energy/water management services and products e.g. low demand/volume devices
- Site remediation e.g. soil decontamination
- Cross media emissions control e.g. prevention of soil to air/water contamination transfer

Opportunities in Waste Management

Common Approach To Commercialization Stages:

1. Technology
2. Money
3. Management

More Successful Progression:

1. Management attracts
2. Money which attracts
3. Technology

Growth Potential

Some Project and Program Experience To Date:

The Environmental Technologies Program (ETP) Program:

- Administered by MOE. Technical reviews by MOE and commercialization, financial/managerial by MITT
- Application decisions by Environmental Technologies, Advisory Committee, (MOE, MITT, Energy, Treasury, Innovation Ontario, Environment Canada, NRC, Premier's Tech. Fund)
- $30 million over 5 years. Approximately $14 million committed over 40 projects on matching funding basis
- Up to 3 years support on matching funding basis for applied research and demonstration projects leading to commercialization in Ontario.

Program Experience with Commercialization, Financial and Managerial:

- Technology innovation often missing sound business plan, understanding of potential market and competition for the technology
- Limited financial resources and management team experience reduce strength of applications. Need to strengthen proposal with strategic partnerships and broader understanding of market, competing technologies and marketability for technology.

Growth Opportunities
Strategic Alliance Potentials

Researchers	-	Manufacturers	e.g. Laboratories and Manufacturers (WTC - Zenon)
Consultants	-	Manufacturers	e.g. Consulting engineers and manufacturers
End User	-	Supplier	e.g. Technology development and licensing (Zenon-GM)
International Firms/Agencies	-	Domestic Suppliers	e.g. Licensing, joint ventures (TEKKES Finland, 4 Motors)
Competing/ Complementary Firms	-	Consortia	e.g. Albarrie Canada - air emissions control consortia interest

The best opportunities will probably occur for specialized products/services. Traditional waste management firms will acquire new technologies and staff to diversify into new business, e.g. waste transfer to site remediation, while start up firms will develop or acquire technology to commercialize and capitalize on market opportunities.

Companies may be linked in clusters for competitive and coöperative purposes. Clusters are defined as groups of companies that are linked through shared customers, suppliers, workforce skills or a common technology.

Growth Potential

Where will The Alliances Come From? Some Potential Partners:

<u>Industry Association Members:</u>

- Ontario Waste Management Association
- Ontario Pollution Control Equipment Association
- Canadian Environment Industry Association
- Air and Waste Management Association
- Canadian Association of Recycling Industries
- Canadian Manufacturer's Association
- Greater Toronto Home Builders Association
- Consulting Engineers of Ontario
- Pollution Control Association of Ontario
- Canadian Chemical Producer's Association
- Canadian Pulp and Paper Association
- Environment and Plastics Institute of Canada (EPIC)

<u>Government:</u>

- Environment Canada
- Industry, Science and Technology Canada
- External Affairs and International Trade
- National Research Council
- Energy, Mines and Resources
- CANMET
- Ontario Ministry of Environment
  - Environmental Technologies Program
  - Industrial Waste Diversion Program
  - Tire Recycling Program
  - Environment Research Program
- Ont. Ministry of Energy
  - Green Industry
  - EnerSearch
  - Market Entry of Energy Efficiency Technologies

Government (continued...)

- **Ont. Ministry of Industry, Trade and Technology**
  -Domestic Field offices
  -Strategic Alliances staff
  -Foreign offices
  -Trade and technical personnel programs
  -Innovation Ontario
  -Ontario International Corporation
  -Technology Fund (Industry Research Program)
  -Ontario Ministries of Agriculture, Natural Resources, Mines and Northern Development, Skills and Development

Industry Sectors:

Energy, Chemical, Mining, Forestry, Petroleum, Telecommunications, Construction

Agencies/Institutions:

- **Centres of Excellence (e.g. Waterloo Centre for Groundwater Research)**
- **ORTECH International**
- **Wastewater Technology Centre**
- **Ontario Hydro**
- **Manufacturing Research Corporation of Ontario**

Growth Potential

Industry	Growth In Client Base in Past Five Years	Average Employee Salary
A (Major League Baseball)	9.3%	$1.02 Million
B (National Football League)	13.8%	$492 K
C (National Basketball Association)	19.2%	$1.2 Million
D (National Hockey League)	4.1%	$408 K
E (Canadian Football League)	7.0%	$60.9 K

Growth Rates

1.	The Canadian Economy	2.0 - 2.3%	(1992)
2.	Canadian Football League	7.0%	(last 5 years average)
	National Basketball Association	19.2%	(last 5 years average)
3.	The North American Environmental Protection Industry	7-10%	(next five years)

While not as visible as major trends in sports attendance, growth expectations for environmental protection industries exceed that for the overall national economy; a significant consideration when planning your business activity. While exact figures are hard to predict, it is safe to say that the future growth of the environmental protection industry is expected to be somewhere between the past growth of the CFL and NBA!

Sources:

1. Finance Minister Don Mazankowski, 1992 International Monetary Conference; Toronto Star, June 3, 1992; League and players unions; Globe and Mail, May 29, 1992; Ontario Ministry of Industry, Trade and Technology and Industry, Science and Technology Canada reports.

Growth Potential

Ontario Environmental Protection Industry

1. Ontario Industry:

   - 1,200+ Companies
   - 28,000 Ontarians
   - $1.5 - 2.5 Billion in Sales
   - Greatest technology strengths in services sector and technologies related to water and wastewater treatment. Largest employment in waste management sector.

2. Ontario Environmental Protection Industry in Canada

   56% of manufacturers
   70% of exports
   65% of employment

Sources: Ministry of the Environment, Woods Gordon, 1989
Environment Canada, Ernst and Young 1992

Growth Potential

World Markets For Environmental Protection

Canada:	**$7-10 Billion**
U.S.:	**$130 Billion (Growth to $170 Billion by year 2000)**
E.C.:	**Approximately Equal to North America**
China/South East Asia:	**Taiwan $35 Billion over 10 Years and China Showing Interest in North American Technology**

Growth Potential

Some of the Drive for Growth Opportunities:

- Energy demand management (e.g., Ontario Hydro Demand Side Management Unit, Ontario Hydro $6 billion investment in DM by year 2000)
- Federal/provincial emphasis on Technology Transfer (e.g., Proposed Environment Canada Technology Transfer Centres)
- Shift to pollution prevention in preference to end of pipe control technologies (e.g., MOE Pollution Prevention Initiative)
- Regulatory Changes (e.g., U.S. Clean Air Act, Ontario MISA)
- Changing Social Priorities (e.g., Green products and practices)

Growth Potential

Some Problems/Opportunties waiting to be "Discovered" and Solved.

- White Goods Disposal and Recycling
- CFC recapture and replacement
- Battery Recycling (Consumer electronics)
- Reusable consumer containers (beyond the beverage containers)
- Ontario Waste Exchange (more regulatory flexibility to create matching supplier-end user volumes addition of new categories and services)
- Electric Arc Furnace Dust, Steel Slag Aggregate, Mine Wastes (tailings - 435 million tonnes, waste rock - 196 million tonnes).
- Asphalt Shingles and other construction, renovation and demolition wastes (15% of waste sent to landfill, initiatives being taken by GTHBA under Build Green Program)
- Automobile disassembly and reuse
- Consumer/Household goods, designed for disassembly and reuse

<u>General</u>

- Largest successes will likely come from low profile initiatives and well planned business development activity

Growth Potential

Framework For An Industrial Strategy For The Province:

- Increasing Technological Capability
- Developing Home Based Companies
- Developing Clusters
- Build International Capabilities
- Continuous Innovation
- Raising Skill Levels

Strategies important to the growth of the environmental protection industry, such as the Green Industry Strategy, will fit in this overall strategy announced by the Minister of Industry, Trade and Technology.

The Green Industry Strategy is being developed by the Ministry of Energy with contributions by Ministries such as MITT (Industrial Strategy), MOE (Pollution Prevention, 3R's), MNR (Water Conservation), MGS (Green Workplace, 3R Program), Housing (Water/Energy Conservation), OMAF, MNDM (SCAN North).

Opportunities for Waste Management Industry to move "up the pipe" in providing goods and services based on technologies and re-manufacturing based on available waste.

Opportunities in Waste Management, In Summary

- Traditional goods and services generally for solid & liquid waste management, e.g. municipal, ICI and hazardous
- Trend and opportunity will be to expand waste "management" to waste prevention and reuse ranging from recycling to process design and energy and water conservation.
- Opportunities will occur in wide range of goods/services from manufacturing to process design changes to energy/water conservation.
- Challenge for existing waste management industry will be to diversify to meet new market opportunities.
- Opportunity for new firms will likely be specially goods and services (e.g. pollution prevention, energy, and water conservation and re-manufacturing) rather than in full service waste management.

Growth Opportunities

Sources of Information

Forthcoming Studies:

1. Ministry of Environment update to the 1992 Woods Gordon Study on the Ontario Environmental Protection Industry and Markets

2. Statistics Canada Waste Management Survey (economic data on firms in the industry and fate of the waste)

3. Statistics Canada Municipal Waste Survey (types of waste management operated by municipalities or contracted out)

Past Studies:

1. ISTC, Environment Canada, MITT (U.S. and European markets)

NATIONAL EMISSIONS REDUCTION MASTERPLAN (NERM)
A Responsible Care[R] Initiative of CCPA

Don A. Hames
Dow Chemical Canada Inc.

Harold W. Quinn
Consultant to CCPA

INTRODUCTION

The Canadian Chemical Producers' Association (CCPA) represents over 60 companies in Canada engaged in the manufacture, distribution and sale of chemicals and allied products. In the mid-80's, CCPA adopted a policy of Responsible Care[R] under which every member company is committed to taking every practical precaution towards ensuring that products do not represent an unacceptable level of risk to health and the environment. Since its inception in Canada, the Responsible Care commitment has been adopted by chemical industry trade associations in a number of countries. In 1990, Responsible Care was recognized with a Global 500 award presented by the United Nations Environment Program.

Responsible Care has a set of guiding principles which states that every member Company will:

* ensure that operations do not represent an unacceptable level of risk to employees, customers, the public or the environment;

* provide relevant information on the hazards of chemicals to customers, urging them to use and dispose of products in a safe manner and make such information available to the public on request;

* make Responsible Care an early and integral part of the planning process leading to new products, processes or plants;

* increase the emphasis on the understanding of existing products and their uses and ensure that a high level of understanding of new products and their potential hazards is achieved prior to and throughout commercial development;

* comply with legal requirements which affect its operations and products;

* be responsive and sensitive to legitimate community concerns;

R: Responsible Care is a registered trademark of the Canadian Chemical Producers' Association

* work actively with and assist governments and selected organizations to foster and encourage equitable and attainable standards.

The documents which are the substance of the guiding principles and which outline the specific performance expectations of Responsible Care are six Codes of Practice. These address Research and Development, Manufacturing, Hazardous Waste Management, Transportation, Distribution and Community Awareness and Emergency Response (CAER). Each code of practice has an accompanying set of milestones which represent significant steps in the management of the code implementation process. These milestones also provide a means by which progress can be easily measured.

Two of the codes of practice, the Manufacturing Code and the Hazardous Waste Management Code, identify, as priorities, the development of inventories of environmental emissions and programs for reduction of them, while a third, the Community Awareness and Emergency Response Code, specifies the need for public disclosure. The CCPA has embarked upon a program to address these priorities. As the title of this paper indicates, it is called the National Emissions Reduction Masterplan, which I shall subsequently refer to as NERM.

NERM

NERM, as a multifaceted initiative, will encompass:

* an inventory of chemical-specific emissions to all environmental media from the operating facilities of CCPA member companies;

* a database of hazardous and non-hazardous waste experiencing off-site waste management;

* monitoring of the reduction of chemical-specific emissions and of waste generation and setting of reduction targets;

* communication to the public of aggregate emissions and waste data and of reduction accomplishments and projections.

The collection of emissions and waste data has begun on a voluntary basis for 1991. Member companies have been encouraged to respond in order that both they and the CCPA can gain some experience with the NERM process. However, reporting of 1992 emissions in 1993 will be mandatory for all operations. It is on the basis of those 1992 emissions data that the CCPA will be able to develop aggregate data for communication with governments and the public.

The key instrument for collection of the desired data under the NERM initiative is a three-part survey. Part A provides information relating to the identity of reporting facilities, Part B collects annual chemical-specific emissions data and Part C reports annual total waste destined for off-site waste management. I shall now take a few minutes to discuss each of these.

THE SURVEY

PART A

Part A of the survey permits identification of the geographic location of an operating facility, which will allow aggregation of emissions data on a national or regional basis. A facility is defined as operations under common local management and it may include off-site installations such as warehouses or landfills. Part A also identifies a knowledgeable contact for the information provided. For companies with a number of different operating facilities, a complete survey must be filed for each. However, corporate coordination of the survey and submission to the CCPA of a single package containing surveys for all locations have been requested.

Part B

Part B is the most comprehensive component of the entire survey. It is designed to require chemical-specific reporting of emissions to all environmental media, i.e. air, water or land, from particular on-site emission sources of chemical substances of health and environmental concern. For example, emissions of a particular chemical to the air will be identified to have originated from stack or other point sources, from chemical storage or handling sources, from fugitive sources such as leaking valves or pumps, from spills or from other non-point sources such as waste water treatment facilities or landfarms.

In addition, Part B collects data relating to the quantity of a specific chemical associated with wastes leaving the facility for off-site waste management. While it is not a foregone conclusion that this chemical will be emitted to the environment, the fact that it has left the site and is thus not under the direct control of site management introduces the possibility of environmental emissions. An awareness of this potential may in itself provide an incentive to reduce the quantity of off-site waste or, at least, the quantity of the chemical associated with it.

For identification of chemical species for reporting purposes, a list of over 300 chemicals has been provided as a starting point or a minimum. At present, the core of the list is the current U.S. EPA Section 313 Toxic Chemical List. To that has been added a number of other chemicals of environmental concern, such as CO_2, NO_x, SO_x, alkanes from methane through hexane, alkenes from 1-butene through 1-hexene and acetylene. These additional compounds relate to such environmental concerns as global warming, acid rain and tropospheric ozone. Even with these additions, it is recognized that the list does not necessarily identify all chemical substances of health and environmental concern. Reporting companies have been encouraged to develop an awareness of all emissions and to report any which they think may be of concern. It is to be expected that the chemical list employed will undergo additions and/or deletions as its validity is tested by our experience with it.

Although the survey is designed to encourage chemical-specific reporting of emissions, it is recognized that, in some instances, the reporting facility will be dealing with mixtures of chemicals, perhaps in starting materials and/or product streams, and, most certainly, in process and waste streams. To the extent that the chemical-specific composition of such mixtures can be reasonably determined, chemical-specific reporting of emissions is expected. If, however, it is not possible to provide chemical-specific identification of a mixture, it is sufficient to use the generic or chemical family identity, e.g. C_6-alcohols.

There is, also, the question of whether to report emissions regardless of how small the quantity of a substance encountered at a facility or how small its environmental emissions. Two criteria have been adopted to assist responders in this regard. These state that emissions of substances of health and environmental concern must be reported if:

1) the quantity of the chemical acquired for use at or produced by the facility exceeds 10,000 kg per year, and

2) the emissions of that chemical from all sources at the facility exceed 1000 kg per year.

These are criteria which are considered satisfactory for NERM reporting at this stage of the process. They certainly will assure reporting of major emissions. However, within the context of the Responsible Care commitment, responders have been encouraged to report emissions of less than 1000 kg per year, if the substance involved is known to be of high health or environmental concern.

Member companies have been asked to use the estimation methods which they consider to be most appropriate. With emissions to water and land, the determinations are quite straight forward, involving knowledge of the total quantity of material emitted and the concentration of the chemical species involved. With emissions to air, on the other hand, the estimations are more complex and the data accuracy will be influenced by the level of sophistication of the methods employed. For small quantity emissions, the impact of data errors will not be great. For larger emissions, however, it could be and it is expected that responders will upgrade the level of sophistication of estimation methods for such situations. Recognizing that there will be some error associated with all submitted data, facilities have been asked to provide their best estimate of emissions to two significant figures.

The section of Part B which addresses transfers of a chemical in wastes to off-site locations requires reporting of the total quantity of the chemical in kg per year and information relating to what happens to the waste after it has been transferred. Responders are asked to indicate whether the waste, and thus the chemical, was recycled, reused or recovered (either as material or energy content recovery), was destroyed biologically or by incineration, was contained by landfill, underground injection or other storage or received some other treatment. This reporting of the destiny of the waste is in terms of the percentage of the whole. This information will provide a basis for monitoring change in waste management strategy with time for particular types of waste.

The final section of Part B reports the change in chemical-specific emissions from the previous year and encourages facilities to consider the emission reductions possible over each of the succeeding five years. These projections will not be considered to be defined targets to be met. However, since one of the primary goals of this program is to provide a basis for setting of emissions reduction targets, the projections should reflect realistic goals and will, we think, stimulate the necessary activity to accomplish them.

PART C

Part C of the survey is not, in fact, a survey of emissions, but rather one of total waste destined for off site waste management. It requires reporting of waste quantities in tonnes per year for both hazardous wastes, as defined by the pertinent provincial regulatory agency, and non-hazardous wastes. It distinguishes between routine waste, that arising from the on-going scheduled activity at the facility, and non-routine waste, such as that resulting from unscheduled activity such as spill cleanup, storage tank sludge clean-out, etc. Within each of these categories, there is a further more specific identification of the waste, such as waste water and packaging waste.

There is, as in Part B, a need to identify the type of waste management technology used off-site, as well as to provide a comparison of the total waste quantity for the year of reporting with that of the previous year and a projection of the quantity of such waste for each of the next five years. Again these projections should reflect the identification of waste reduction targets and stimulate a waste minimization program at the facility.

Member companies are encouraged to provide also information relating to particular emission or waste reduction accomplishments. This can be in an anecdotal format and will provide insight for others into how these may be achieved.

MANAGEMENT AND COMMUNICATION OF DATA

The development and distribution of the survey has been, to this point, the key focus of this program. Attention is now being given to how best to establish a system for management of the data and how best to aggregate it for communication purposes. These decisions will be made in the very near future. Because response to the survey of 1991 emissions is voluntary, it is not expected that there will be a response by the total CCPA membership. Consequently, there will be no public communication of aggregate data for that year. However, member companies have been encouraged to communicate their own emissions data to their respective communities.

The situation will be different, however, in 1993. Response to the survey of 1992 emissions will be mandatory and it is expected that CCPA should be able to communicate meaningful aggregate data for that year. These may be chemical-specific aggregates or expressed as VOC or greenhouse gas emissions.

RELEVANCE OF NERM TO OTHER INVENTORIES

While NERM is a proactive initiative of the CCPA, it is not the desire nor the intent of the CCPA that it should result in an isolated database. There are other initiatives currently underway at the federal and provincial levels to generate emissions inventories. These include NO_x/VOC and greenhouse gas inventories, as well as the National Pollutant Release Inventory (NPRI). CCPA has been involved in consultations relating to all of these. It is expected that the database developed under NERM will allow the CCPA to provide meaningful data relating to emissions from the Canadian chemical industry to all such national or provincial inventories.

SUMMARY

In summary, the Canadian Chemical Producers' Association sees the National Emissions Reduction Masterplan as an important and a necessary initiative under the Responsible Care commitment. The survey, currently in its experimental phase, will provide, in the short term, valuable experience in the collection of meaningful and useful emissions and waste data and, in the longer term, a valuable database for the establishment of realistic reduction targets for the industry and monitoring of progress toward the meeting of those targets. We appreciate the opportunity which this conference has provided us to make you aware of this initiative.

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RECYCLING AND "DO IT YOURSELF" (DIY) OIL CHANGES

ONTARIO CONFERENCE ON THE ENVIRONMENT

TORONTO: JUNE 15, 1992

WAYNE WRIGHT
VICE PRESIDENT - C.P.P.I.

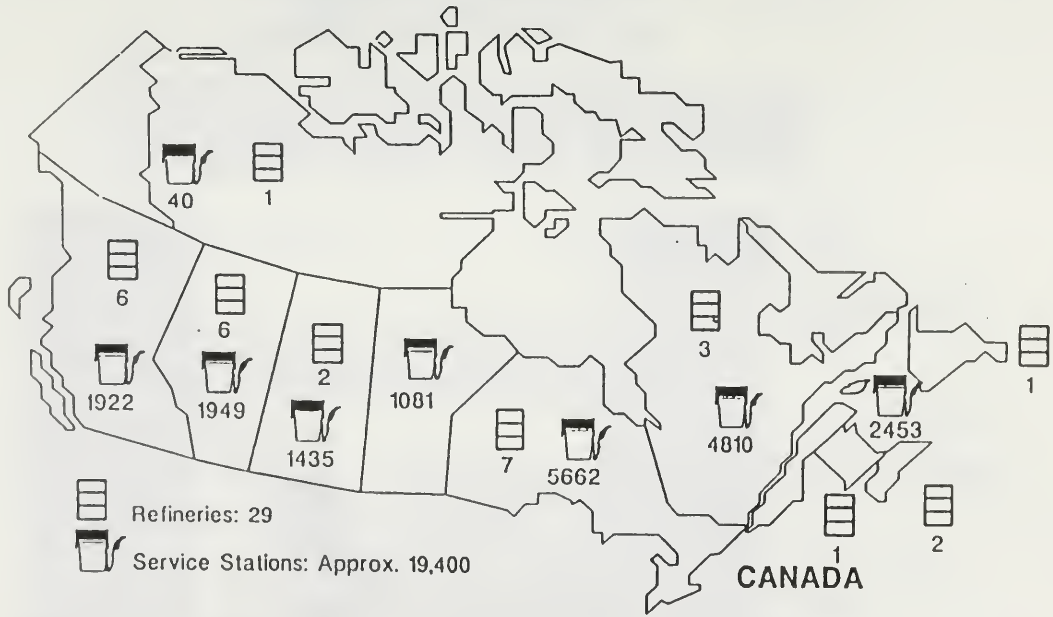
CPPI MISSION STATEMENT

CPPI'S mission is to proactively serve and represent the refining and marketing sectors of the petroleum industry on environmental, health, safety, and business issues affecting the industry and Canadian society.

CANADIAN PETROLEUM PRODUCTS INSTITUTE

Refining and Marketing

A Strong Presence In All Regions of Canada



More than 100,000 Canadians are directly employed in Refining and Marketing

Petro-Canada - MRR

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USED OIL SITUATION

One billion litres sold in Canada

500 million litres used oil

250 million litres collected

250 million litres missing

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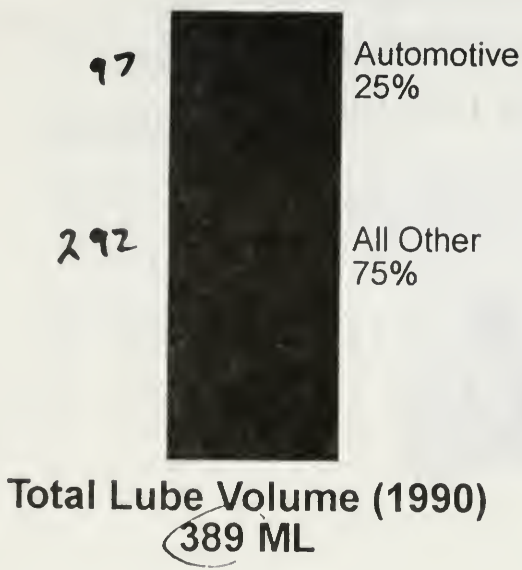
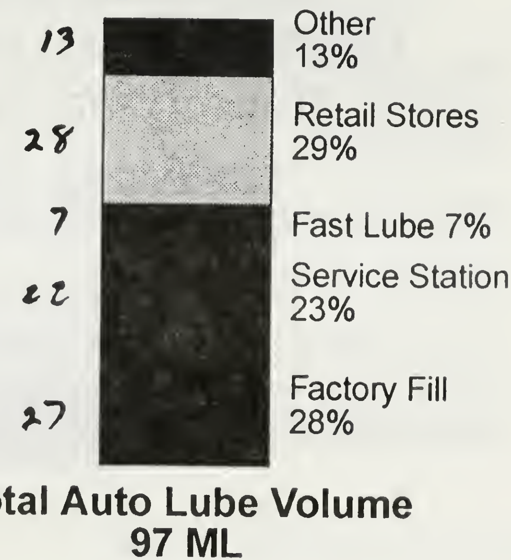
ONTARIO PERSPECTIVE





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ONTARIO DIY IMPACT

40 Million litres unaccounted
25% consumed/lost (conservative)
30 Million litres uncollected

D.Y.I. Impact

Of Sales	$\frac{41}{389}$	10%
Of Uncollected	$\frac{30}{70}$	40%

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USED OIL IN ONTARIO ('000 L/YEAR)

THUNDER BAY	2,300,000
SUDBURY	2,900,000
WINDSOR	5,200,000
TORONTO AND REGION	103,800,000
OTTAWA AND HULL	15,600,000
TOTAL	129,800,000

(Source: Monenco Consultants)

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USED OIL IN ONTARIO DISPOSAL PRACTICES

SERVICE STATION	35%
WASTE DEPOT	28%
USE ELSEWHERE	3%
STORED	10%
GARBAGE	3%
RECYCLING DEPOT	6%
DISCARD ON ROAD	5%
LAND FILL	4%

(Source: ISL International Surveys)

CANADIAN PETROLEUM PRODUCTS INSTITUTE

USED OIL IN ONTARIO PREFERRED COLLECTION OPTIONS

RETURN TO SERVICE STATION	65%
RECYCLING DEPOT	44%
WASTE DISPOSAL DEPOTS	47%
HOME PICK UP	12%

(Source: ISL International Surveys)

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CPPI USED OIL PLAN BASIC PRINCIPLES

Everyone A Stakeholder

- Is an environmental issue which must be resolved by everyone involved
  - The lubricants sellers
  - The lubricants users
  - Various responsible gorvernments
- Each has a role to play
- Each must participate

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ROLE OF EACH PLAYER

Sellers - Provide used oil disposal system

Consumers - Return used oil

Governments - Referee the program

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SELLER RESPONSIBILITY

Provide the means by which their customers can properly manage their used oil

Market forces ensure cost effectiveness and competition

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CONSUMER RESPONSIBILITY

- Proper management and return of uncontaminated used oil
- Information, and participation

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GOVERNMENT AS REFEREE

Two disposal options for each region

Protect collectors from abuses

Educate "Consumers"

Require all sellers to participate

CANADIAN PETROLEUM PRODUCTS INSTITUTE

LESSONS WE LEARNED

1. Define Government Role
2. Pre-test and Sell Your Program
3. Profile Your Issue
4. Promote a Program, Not Promises
5. Rely on Market Forces
6. Persevere

INTEGRATING THE 3R'S INTO PRODUCT MANUFACTURING

NOTES FOR AN ADDRESS BY:
IAN TEDFORD
MANAGER ENVIRONMENTAL PROGRAMS
XEROX CANADA LTD.

to

39TH ONTARIO CONFERENCE ON THE ENVIRONMENT

JUNE 15, 1992

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SLIDE 1

Good afternoon Ladies and Gentlemen. It's a pleasure to join you for the "39th Ontario Conference on the Environment" and an honour to be asked to share our experiences with such a long standing Environmental Forum.

Today I'd like to share with you some of the things we're doing at Xerox Canada to manufacture better products. Products that meet or exceed the needs of our Customers, help conserve Resources and play a role in the protection of a world we all call home.

CORPORATE GREENING

1980 - Xexox Environmental Policy

Xerox is committed to the protection of the environment and the health and safety of its customers, neighbours and employees.

SLIDE 2

First, let me share some Xerox Environmental Policy History with you:

In 1980 we formulated our first formal Environmental Policy.

--- emphasis on---Environment
---Health and Safety

CORPORATE GREENING

DECEMBER 3, 1990

This is my personal communication with you, the Management Team of Xerox...

"The standards we set for ourselves and for our products go beyond many government requirements for health, safety and environmental protection. We believe our environmental health and safety standards make good sense for our employees, our neighbours and our customers, and good business sense for us."

Paul A. Allaire
President and Chief Executive Officer
Xerox Corporation

SLIDE 3

Our First Policy lasted for a decade then 18 months ago Paul Allaire our CEO added to it.

. . . he instructed us to go beyond Requirements and Regulations.

. . . and concluded that Concern for the Environment made good business sense.

CORPORATE GREENING

1991 ANNUAL REPORT

“ Xerox is committed to designing its products for optimal recyclability and reuse. Xerox is equally committed to taking every opportunity to recycle or reuse materials generated by its operations.”

Paul A. Allaire
President and Chief Executive Officer
Xerox Corporation

SLIDE 4

Five months ago Paul amended our existing Environmental Policy to include specific product direction.

. . . Xerox Senior Management is providing Environmental Leadership, and Environmental momentum within Xerox.

. . . Designing Equipment for Optimal Recyclability and Reuse is key in Reducing our reliance of Natural Resoarces

. . . Additionally, and maybe more importantly, we're finding our employees and customers expect us to enable them to protect the environment.

CORPORATE GREENING

ENVIRONMENTAL REQUIREMENTS

- Reduce
- Reuse
- Recycle

SLIDE 5

Lets first look at the environments requirements, basically the 3R's.

. . . We have to "continuously improve" the application of the 3R's in Product Manufacturing, in fact into everything we do.

. . . The 3R's are becoming part of Ontrario's Culture they also are becoming part of Xerox Corporate Culture.

CORPORATE GREENING

CUSTOMER REQUIREMENTS

- Quality
- Performance
- Value

SLIDE 6

. . . Know, I'd like to look at our customers requirements. With the help of Goldfarb Consultants our Market Research Agency we've completed some very extensive research to determine our customer environmental requirements in a array of specific areas. . . for example packaging/ services / supplies / delivery / billing, and product.

. . . We've completed 4,000 Customer Telephone Interviews. . . conducted several Customer Focus Groups. . . We've also conducted a series of Employee round tables with our front line Sales and Service people.

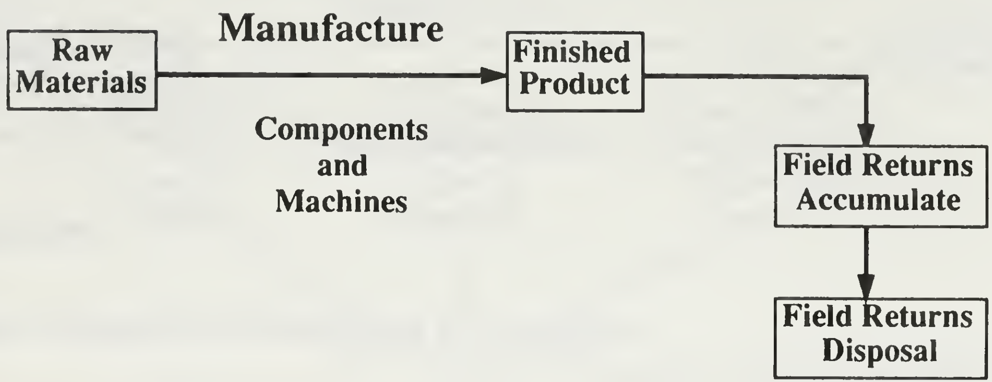
. . . In essence our customers respond favorably to environmental initiatives if these Basic attributes - Quality, Performance, and Value are maintained or improved.

Elaborate - Quality
- Performance
- Value

. . . Our Xerox Quality Process has taught us to . . . Ensure we understand Customer requirements before we develop specifications and work processes. . . our Customers requirements for Quality, Performance, and Value must be built into all our Environmental Initiatives

CORPORATE GREENING

TRADITIONAL MANUFACTURING PROCESS



SLIDE 7

Traditional Manufacturing Process

. . . Know Lets go on to Manufacturing

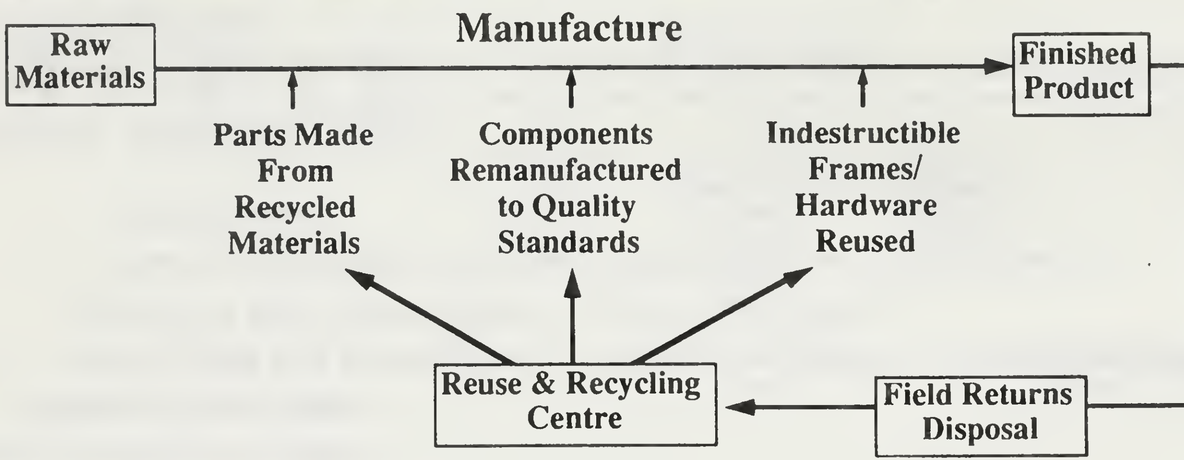
. . . Raw Materials manufactured into Product

. . . Disposal

- Special treatment materials managed by Xerox
- Scrap to dealer
- rest to Landfill

CORPORATE GREENING

TRANSITIONAL MANUFACTURING PROCESS



SLIDE 8

Transitional Manufacturing Process

. . . Reuse and Recycle Centre

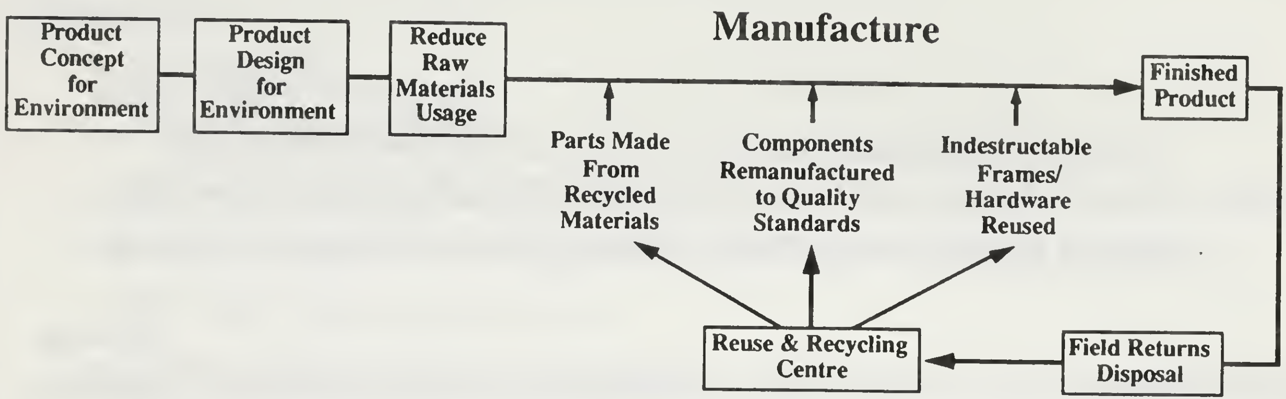
- Product Disassembly
  - Some parts can be reused in "if there is a market " in the manufacturing process if they meet original Quality Standards, ex:
    - Frames and lenses that have never been subject to wear or deterioration

- Some components can be remanufactured to original or improved Quality Standards, ex:
  - Electronic circuit boards
  - Panels
  - Wiring harnesses

- Same parts can be made from recycled materials, ex:
  - coatings reclaimed from Photoreceptor Belts

CORPORATE GREENING

IDEAL MANUFACTURING PROCESS



SLIDE 9

Ideal Manufacturing Process

. . . To reduce raw material usage, and maximize parts reuse and material recycling we have to think environmental much earlier in the Manufacturing Process

- Think of environmental requirements during the products concept
- Build environmental product specification in at the Product Design Stage

  . . . Always remembering the Customer Requirement for Quality, Performance, and Value.

CORPORATE GREENING

PRODUCT DESIGN FOR ENVIRONMENT

Examples:

- Disassembly
- Part Commonality
- Extend Components/Part Life
- Limit Metals/Plastics to Select Few and Code for Recycling
- Revised Cleaning Process
- Reduce Energy Requirements

SLIDE 10 (continued)

- Revised Cleaning Processes
  - Maximize use of Natural Processes,
    ex Citrus based cleaners
    Pressure / Temperature

- Reduce Energy Requirements
  - Example - Toner Fusing Temperature
    - Customer Programmable Power Savers
    - New Electric Motor Technology

SLIDE 10 Product design for the environment

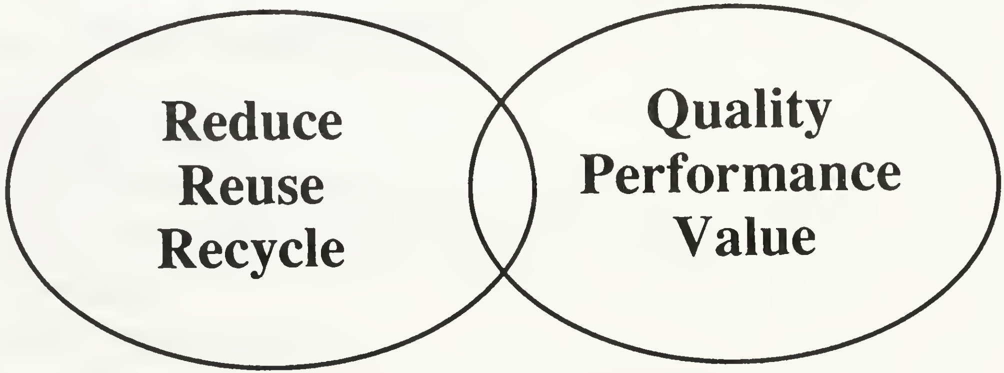
let me review Examples of Environmental Factors that are considered at the Product Concept and Design Phase.

- Disassembly
  - Product Simplification
  - Fewer Parts
  - Component subassembly
  - Limit Permanent Bonds
  - Maximize Snap Fits
- Designing for Part Commonality
  - same part for Several Products

  - Same part for future models
- Extend Components Part / Life "build to last until its time to take it apart"
  - Materials specification
  - Design
- Limit Metals / Plastics "Conserving vs consuming"
  - Easier sorting / higher recycle values
  - Fewer recycle streams

CORPORATE GREENING

ENVIRONMENTAL CUSTOMER PARTNERSHIP



SLIDE 11

Environmental Customer Partnership

. . . To be successful its essential that we form a Environmental Customer Partnership. A partnership that combines the needs of the Environment with the additional needs of our Customers.

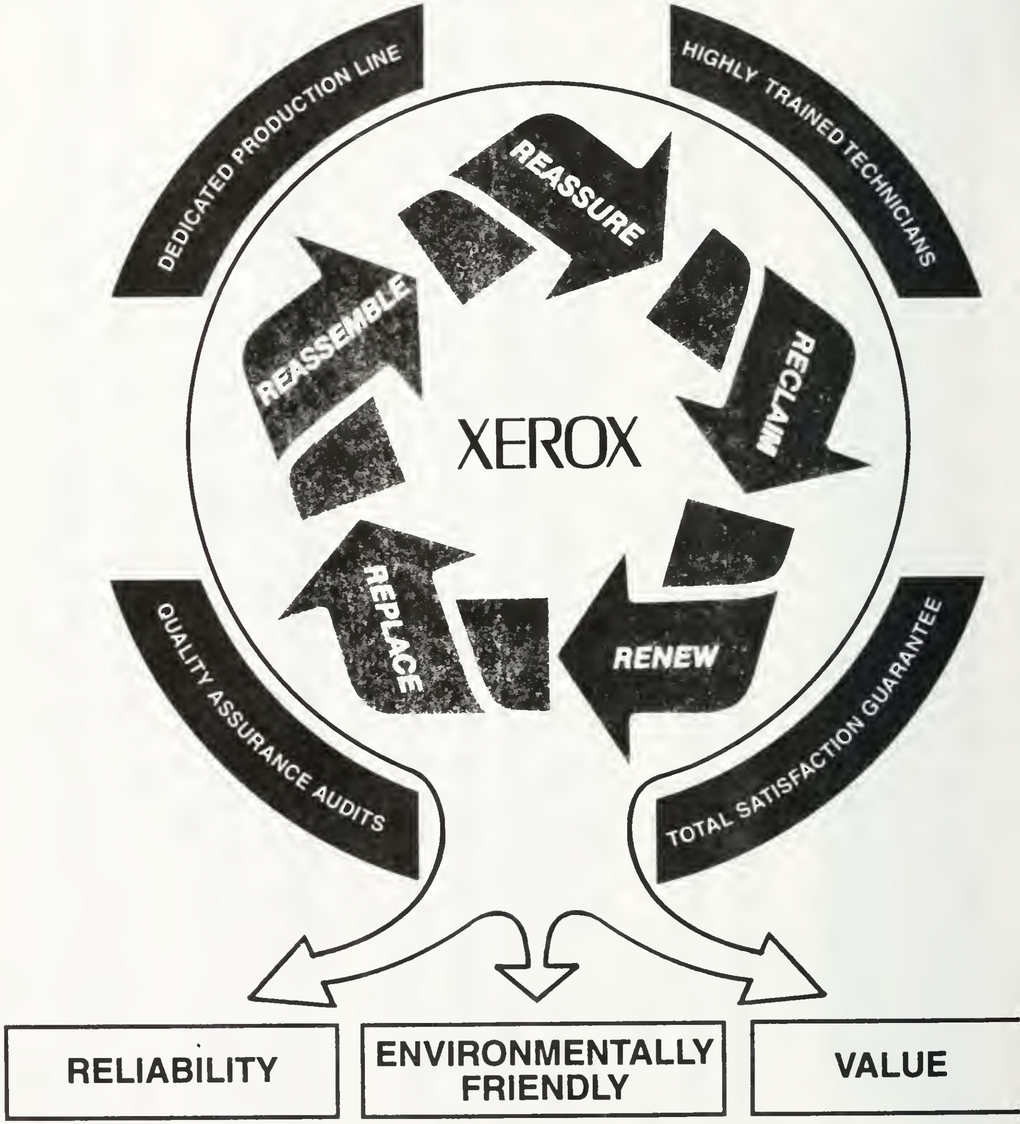
. . . "Excellence in Environmental Stewardship and in the Development of Environmentally Sound Products and Practices" is a desired State that can be attained.
. . . but attained. . . and this can be accomplished. . . in a manner that always offers Customers' Benchmark Quality, performance, and Value.

. . . We have committed ourselves at Xerox to a never-ending search for things we, a one company, can do to protect the environment. It is a commitment we take just as seriously as the business commitment we make to our customers.

. . . We do it because its the "right thing to do," for our Customers, our employees, our neigbors, for our children and, most certainly for the generation that will follow us.

. . . Thank You

XEROX REMANUFACTURING TOTAL SATISFACTION GUARANTEED



- The unique Xerox remanufacturing process
- The Xerox Total Quality Assurance Program
- The Xerox benefits at work

'NIQUE PROCESS

hXerox five step remanufacturing
:ess ensures your equipment will per-
to the highest Xerox quality stadards.
guarantee it.

PERFORMANCE ASSURED

You can relax in absolute confidence that your Xerox equipment will answer your business demands with trouble-free performance.

THE RESULTS OF EXCELLENCE

Xerox demands the best from its people and its products. We make sure your machine delivers maximum results - copy after copy.

:CLAIM

educe the machine to its framework
lean it thoroughly. Major subassem-
are broken down and evaluated.

'NEW

ndestructible hardware is refinished
reused. This makes maximum use of
e materials and helps minimize landfill
a·.

'PLACE

itical components subject to wear are
tested to ensure full life expectancy
placed. Wherever a part has been
ded since the product was first intro-
d, Xerox installs the latest version of
rt.

'ASSEMBLE

nachine is reassembled on a dedicated
ction line under a comprehensive
ction process carried out by highly
d technicians.

'ASSURE

le inspection takes place at every sta-
ensure quality standards are met.
mponents undergo a rigorous and
ugh testing program.

quality and machine reliability test-
n run up to thousands of copies,
various grades of paper and Xerox-
ed pattern tests.

STANDARDIZED PROCESS

We start with a proven successful product, we add the latest technological improvements and we remanufacture according to documented procedures.

FACILITIES AND PEOPLE

The Xerox remanufacturing operation is a comprehensive process based on sophisticated equipment and an integrated facility.

Highly trained engineers and technicians carry out every stage of the process. These dedicated experts are proud of their work because they know each machine will perform to the highest Xerox standards.

QUALITY ASSURANCE

To ensure total performance integrity, all in-line inspections, copy quality tests and reliability examinations are verified by an independent Xerox audit laboratory.

TOTAL SATISFACTION GUARANTEE

If you are not satisfied with your Xerox remanufactured machine, Xerox Canada will replace it at your request, without charge to you, with an identical model or one with comparable features and capabilities.

This is the same three-year guarantee we provide with all our products covered under a Xerox full-service agreement.

You can be sure of continuing reliability, value for your money and a Xerox machine that meets your business needs.
We guarantee it.

RELIABILITY

Product quality makes the difference. We meet the toughest specifications and the tests prove it. The result is long-term on-the-job reliability.

VALUE

The Xerox name is famous for quality. You get full value for your investment because our equipment lives up to that reputation in every way.

ENVIRONMENTALLY FRIENDLY

We're proud to recycle. Like you, we want to help protect the environment.

XEROX **The Document Company**

XEROX
TOTAL SATISFACTION GUARANTEE

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5650 Yonge Street
North York, Ontario
M2M 4G7

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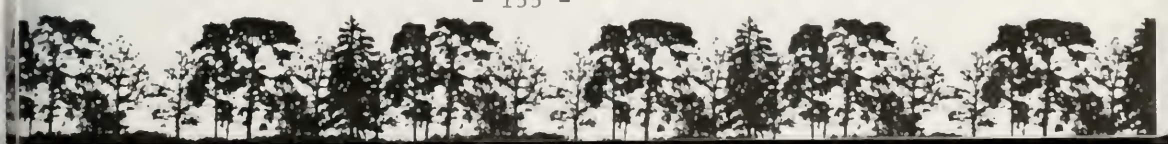


THE BELL CANADA ZERO WASTE PROGRAM

by
Rose Todorski and Dave Burman,
Facilities Management, Bell Canada
Etobicoke, Ontario

Bell Canada is planning on taking waste reduction in the office to new heights in the 1990's.

Bell has set up a pilot project to reduce waste from their 12 story, 25,000 square metre building in Etobicoke, Ontario. Their objective is to make this facility a model environmental building by generating zero garbage and showing that waste reduction can be achieved without large cost.

In 1989, the building used to produce 910 kg (1,800 lbs) of garbage daily. By April, 1991, that amount had been cut down to 320 kg (700 lbs) through conventional paper, glass and can recycling. The Zero Waste program was implemented in July 1991 to further reduce waste. By the end of the year, it was down to 34 kg (75 lbs) daily. Their goal is to have their 1000 employees generate only 5 lbs per day.

Prior to the Zero Waste Program, 75 to 80 bags of garbage were put out each day costing $35,000 yearly to haul away. By the end of 1991 only 3 to 4 bags were generated from the office and cafeteria at a small fraction of the cost. Using $18,000 to start the project, Bell estimates the investment pays for itself in less than eight months. More importantly, Bell feels that the enthusiasm and support generated among the employees and the benefit to the environment is beyond calculation.

The key to the project's success, has been teamwork and the company's emphasis on the altruistic benefits of waste reduction for the environment rather than the financial considerations of Bell's bottom line. Bell Canada has begun to extend this program to all of its buildings and has produced a handbook outlining the procedures involved in the zero waste program.

The program includes:

•Setting targets for materials such as polystyrene, mixed plastics, paper towels, carbon paper, paper recycling, corrugated paperboard, glass, cans and composting of food wastes.
•Doing a waste audit to discover how much of what types of waste was being produced. Even though they had a comprehensive paper recycling program in

place, the audit revealed that 75% of the waste was contaminated paper, 20% was food waste (mostly from the cafeteria) and 5% was plastics.

•Setting up a zero waste action committee comprising representatives from Corporate Environment, Facilities Management, Dining Services, Administrative Services, non-management employees and key suppliers.

•Organizing a one week educational program to introduce employees to the project.

•Working with their food supplier to stop using polystyrene cups, dishes and cutlery. Avoiding individual cream, juice and milk dispensers and replacing them with large dispensers, ceramic mugs and dishes and special plastic "Lug-A-Mugs" that were distributed to each employee who are then entitled to a coffee discount in the cafeteria for using them.

•Installing hand driers in the washrooms to eliminate the use of paper towels. (note that purchase and installation of dryers was the largest start-up expense)

•Composting an estimated 140 lbs of food waste per day in 9 accelerator composters placed beside the parking lot. Special small plastic receptacles for organic waste have been placed on each floor and in the cafeteria. These are emptied into the composters each day by the maintenance staff.

•Eliminate the use of two large waste removal containers at the loading dock and cut pick-ups from 5 times per week to one time per week. This also provided extra dock space and reduced the potential for pest problems.

•Changing the perception of what garbage is by placing only one waste can on each floor while placing a recycling basket at each desk. This makes the act of recycling easier and the act of wasting harder.

The building is now about to embark on an energy saving program including test installation of motion detectors, adding light fixture reflectors, reducing the capacity of the hot water tank, etc.

#1 TITLE SLIDE
ZERO WASTE

ZERO WASTE, the story of Bell Canada's initiative to help protect the environment.

#2 STATEMENT OF COMMITMENT

"BELL CANADA is committed to Leadership, Innovation and Excellence" in conducting its business and promoting its services. It will do so in a manner that protects people and their environment."

#3 PHOTO OF BUILDING

2 Fieldway Rd. was selected as the pilot site for Zero Waste because it's a typical commercial building: with Sales, Clerical, Engineering and Marketing staffs.

#4 GRAPHIC - 2 Fieldway Rd.

The 12 storey building at 2 Fieldway Rd. has about 1000 occupants, and it is 257,000 square feet in total. Before recycling started enough garbage.was generated to

\#5 BUILDING GRAPHIC IN
GARBAGE CAN

fill this building every two years. That means, the equivalent of this huge structure was being buried in landfill every 2 years.

\#6 SKYLINE OF TORONTO.

The Toronto skyline is familiar to everyone. Most of those buildings are similar to 2 Fieldway Rd. This graphically illustrates the landfill crisis facing Southern Ontario and indeed North America.

\#7 GARBAGE CAN GRAPH

In 1989, 2 Fieldway road generated just under 2000 lbs. of garbage each and every working day. By early 1991 a traditional recycling program had reduced this to about 700 lbs. per day. On July 2 the Zero Waste program started and garbage was down to 350 lbs by August. By October ....140 lbs. According to the latest measurement in March 1992 2 Fieldway Rd. was down to 48 lbs. per day. That is a 97.4% reduction!

\#8 KEY STRATEGIES

The 7 key strategies used in Zero Waste are:

1. Waste Audit
2. Management Team
3. Non-Management Team
4. Action Plan
5. Kick-off Day

6. Measurement
7. Reaudit & Secondary Plan

#9 WASTE AUDIT - 2 Fieldway Rd.

The first waste audit performed April 1991 showed a total weight that day of 677 lbs.
Paper - 372 lbs. - this is contaminated paper.
Carbon paper - 205 lbs. - this has with it paper which will be recaptured.
Food waste - 59 lbs.
Glass and cans - 24 lbs. - there were simply not enough recovery containers in place.
Styrofoam - 7 lbs. - not a lot in weight, ~~but very visible in the building. Styrofoam~~ represented 35% of the total weight
Other - 6 lbs. included disposable pens, tape dispensers, food wrappers, potato chip bags, etc.
Plastic - 4 lbs. - included packaging and shrink wrap

A traditional recycling program had been in place, so it was quite alarming to find the largest portion of waste in this audit was contaminated paper. The recycling program needed improvement.

#10 MANAGEMENT TEAM

The Management Team was composed of Corporate Environment, Beaver Foods (the cafeteria contractor), Bell's Administrative Services (who administer both stationery supplies and the cafeteria contract) and Facilities Management who manage the building. These people were key in driving change and making budgetary decisions. They worked together with the Associate Team.

#11 ASSOCIATE TEAM
NON-MANAGEMENT TEAM

The associate team is composed of representatives from each of the floors. They are the real sales people of the program. Good candidates for an associate team are Health & Safety reps and union reps because they are respected by their peers.

#12 THE ACTION PLAN

The action plan looked first at elimination.

Styrofoam was banned. Plastic plates, forks & knives; and individual coffee creamers were eliminated. China and cutlery were re-introduced, along with dispensing machines for milk & cream. Convenience packages such as ketchup, relish and mustard were eliminated and the cafeteria returned to bulk dispensers. Jet spray machines for juice were introduced to eliminate juice in plastic containers. The majority of convenience packages were found unopened in the garbage. 2 Fieldway Rd. went back to basics. Paper towels were eliminated since 99% of washroom waste was towelling. Carbon paper hopefully will be eliminated through mechanization or going to NCR paper. Carbon paper is presently being removed by a contractor to recapture paper content only. Carbon paper can be broken down into an ink form and is mixed with another product to make items such as roofing. A feature unique to Zero Waste is the collection of food waste from every floor plus kitchen and cafeteria areas for on-site composting. The recycling of paper, glass, cans and cardboard continued.

#13 TEAM PICTURE

The Recycling team has grown to 24, which provides back-up at monthly meetings. The advantage is that each floor is <u>always</u> represented. This team is key in the program and is involved with high profile days and promotions.

#14 ZERO WASTE KICK-OFF DAY

July 2nd, 1991. The world changed at Bell Canada.

"BELL WENT BACK TO BASICS"

#15 MONTAGE

Zero Waste began with a kick-off day followed by an education week. Each major supplier provided a display in the Main Lobby. The cafeteria displayed posters and new china. The paper recovery people displayed blue waste baskets. The compost people answered questions for employees and donated a composter for a draw. Facilities Management displayed all promotional items handed out at desks that day. It was a high profile day with special invited guests, lots of picture taking and videotaping. Banners hung on every floor.

\#16 RICKY RECYCLE

Bell's Recycling Mascot "RICKY RECYCLE" appeared on all floors to greet employees and add a fun element to the day.

\#17 COFFEE MUGS

Upper management purchased reusable plastic mugs for their employees prior to kick-off day. Each employee received a coupon for their first coffee free in their new mugs. "Lug-A-Mug" was the theme wherever one went. The mug has a safety lid to avoid spills and burns.

\#18 ZERO WASTE ITEMS

As well as the mug, a replica of the curbside blue box was given out at on employee appreciation day along with a blue spruce seedling tree to take home. Employees received a sponge made out of recycled material to help them clean up spills at their desk since paper towels had been eliminated. A magnetic waste clip to hold a plastic bag was offered as an alternative for non-recyclable items to be collected at the desks & deposited in a centrally located bin by employees themselves.

\#19 SWEATSHIRTS

All team members wore golf or sweatshirts to make themselves highly visible. These shirts can also be given out as prizes in draws.

*20 BLUE WASTE BASKET

This is a typical work station today. There is one blue wastebasket and <u>no</u> garbage can. Employees deposit all grades of paper, all colours into this container, as well as window envelopes, envelopes without windows, craft paper, newspaper, magazines, glossy brochures, fax paper, thin cardboard supply boxes, sticky notes. Staples are fine and so are paper clips. Fieldway's paper contractor takes the contents back to the plant for sorting. This is a great help since sorting is labour intensive and space for stock piling is limited. Garbage pick-ups were reduced from 5 per week to 3.

*21 MAGNETIC CLIP

Here's the magnetic waste clip you saw earlier. Bell employees collect "True Garbage" - "non recyclables" ____ _____ hand to mouth garbage for example: kleenex, cigarette boxes, chocolate bar wrappers, and potato chip bags in this plastic bag. At their convenience they walk to a centrally located waste bin and empty out the bag.

*22 CAFETERIA RECYCLE CENTRE

The cafeteria recycle centre is centered around the dish servery since the dish supply needs to be handled and replenished continually. Starting at the clock there is a caddy for trays, glass and can containers; a wall mounted bin for the collection of food waste and then back to the servery. It all works nicely with the flow of traffic. A side door was opened for the employees to use to exit to the park for lunch or breaks. They can now return, drop off their waste items and exit back to the elevators.

#23 HAND DRYERS

Infra-red photo cell hand dryers were installed to replace paper towels. There is no button to push, they time out quickly, and employees like them because the dryers are not still running, wasting electricity while they are already back at their desks. Infra-red photocell hand dryers actually use less electricity than is used in the manufacture of paper towels. Garbage containers in washrooms were locked and employees were asked to walk to centrally located waste containers since there were no more paper towels

#24 REP. SIGNS

Each Zero Waste recycling team rep has a sign over their desk to make them easily identifiable. It's helpful for new staff or people moving into the building who are not familiar with this building's program.

#25 RECYCLE NEWS

Bulletin boards were installed on every floor for Recycle News. They're used for positive feedback to employees, announcements of special days planned, or just telling employees when they are doing well, how many trees they saved and comparing waste reduction month to month. The employees also want to know when things are not going well so they can take action.

#27 PHOTOCOPIER

At kick-off time the building was set up uniformly with containers as high concentrations of carbon paper, photocopying paper, etc. were identified. Containers were added to make the transition easier for the employees and to reduce trips to the paper containers.

#28 GLASS/CAN CONTAINERS

Extra containers were added for collection of glass and cans at the front entrance. Prior to Zero Waste, employees were leaving glass on the concrete. The program eliminated a potential safety hazard.

#29 COMPOST CORNER

At the back of 2 Fieldway Rd., in the parking lot, workmen dug out two parking spaces and installed 9 digesters. The digesters are low maintenance, all seasonal, and work with a modifier. There is a low residual content since modifiers increase water content, and water is absorbed by the surrounding ground area. They are cleaned out once per year, usually in May. There is not enough residual to give back to the employees so it is put back into the compost area. These digesters are used on a rotation basis. Approximately 140 lbs. of waste per day is deposited into them. Of that, 40 lbs. per day is just coffee grounds and filters (that equates to one large green plastic garbage can).

#30 RE-AUDIT

2 months later another audit was done to see if the program had been a success. This time paper contamination had been significantly reduced from 372 lbs per day to 33 lbs. per day. The largest portion now was carbon paper followed by excess

packaging at 77 lbs. per day. This was a new challenge which had not appeared on the first audit. The remaining portions just needed to be fine-tuned. It is important to remember that more than one audit is required.

#31 SUPPLEMENTARY PLAN

Elimination of food packaging was addressed as a result of the 2nd audit. Items such as pre-measured convenience packaged pouches of coffee and cake mixes. The cafeteria went to reusable, refillable containers. Coffee beans are now purchased and ground on site. A new team, working with Administrative Services hopes to eliminate carbon paper soon. In the interim carbon paper is sent out for recapturing of carbon content.

#32 ENVIRONMENT CONTRACTS

Facilities managers hire a myriad of contractors, ie: Plumbers, Electricians. These tradesmen normally used Fieldway's waste facilities for disposal purposes. Environmental clauses are now included in contracts.

#33 CONTRACTS MANAGER/CONTRACTOR

Facilities Management sits down with the contractors before signing a contract and makes it clearly known that as part of the contract, whether they generate waste from the building or bring it with them, contractors must now dispose of it in an environmentally friendly way. If they don't, there will be no future business with Bell Canada.

#34 ZERO PACKAGING

Zero Waste is a continual education process. Facilities Management has made employees aware that when they purchase items such as: computers, and furniture, suppliers are to provide zero packaging.

*35 HOUSE SERVICES CLEANING SUPPLIES

Facilities Management purchases the buildings' cleaning supplies in drums with easy pumps for refilling containers. The cleaners save their convenient size containers and refill as required.

*36 ZERO WASTE FACILITY SIGN

A sign installed at the back loading dock declares the building Zero Waste. Contractors cannot dump at this location. They must take waste off site. The garbage bin is locked with a chain and padlock to make sure waste from outside sources.is not thrown into it.

*37 PAYBACK

Here are some costs and savings and a simple pay back formula. All costs on the left side are one time costs except for the additional hydro factored in for the hand dryers. In hardware $28,000 of the $39,000 is hand dryers with associated electrical costs can be reduced. This ~~was~~ higher since it was the pilot and more was spent on promotional items and the kick-off day. Savings in supplies is almost $12,000, that is, garbage liners and paper towels that do not have to be purchased now. In labour ~~we save~~ 2 pick-ups per week for 1000 people each time, no longer stocking

were saved.

dispensers. Please note that the labour figure is based on a loaded rate which includes all benefits, vacation etc.

Simple Pay-Back
If you take the costs and divide them by the savings over 12 months; after 9 months there is a return to be made. The costs are all one time costs except for hydro. The savings are annual.

*38 BUILDINGS - BAGS ON STEPS

Where is 2 Fieldway today? Well as you can see this is all the garbage per day leaving a building with 1000 people in it.

*39 3 BAGS

The Building's true waste has been reduced from ____ lbs. to 48 lbs. per day. You have probably seen your neighbours take out more on garbage day. That is a 97.4% reduction! Of the 48 lbs. more than half - 28 lbs. is cafeteria waste. . The remaining 20 lbs. per day are from the other 11.5 floors.

*40 ONTARIO & QUEBEC

Zero waste is a corporate program which will cover over 53,000 employees in Ontario and Quebec. In 1992 Bell is scheduled to roll out Zero Waste in about 200 buildings.

*41 PLAQUE

There is a corporate challenge now and any building which reaches an 80% or better reduction in waste, will be awarded a plaque. The first recipient is 2 Fieldway Road. At this time another five locations qualify. The plaque ceremony will be a high-profile media event and an opportunity to show the employees how well they have done.

*42 100 BOROUGH DRIVE

Other buildings on the program include 100 Borough Drive in Scarborough which has achieved an 83% reduction. It is 340,000 square feet and has 1,250 employees.

*43 Future slide of Asquith

*44 20 HUNTER STREET HAMILTON

20 Hunter Street, Hamilton has achieved an 94% reduction. It is 125,000 square feet and has 210 employees.

*45 BELLEVILLE

380 College Street in Belleville is a work centre, which has achieved an 82% reduction. It has 17,500 square feet and 94 employees.

*46 SEMINARS

The Zero Waste Group provides presentations and seminars free of charge to external groups. Bell Canada networks with outside industry to share its knowledge and expertise, and hopes also to learn from others and, to exchange information.

#47 BENEFITS

The Zero Waste program establishes leadership and corporate commitment to the environment. It satisfies employee environmental expectations. A lot of employees asked why it took so long! They want a program in place. They want to help and to be part of the solution. The Zero Waste program reduces daily waste collection and total costs for disposal services from the building. Since Zero Waste is a program for maximum diversion to landfill, Bell will avoid future fines for not complying with new legislation by the Ministry of the Environment. The company wanted to be proactive rather than reactive to to legislation. In doing so, Bell avoids the embarassment of negative publicity. And most important a program like Zero Waste cultivates "team spirit" and "team building".

#48 RCO AWARD

Bell Canada won the 1991 Waste Minimization award for commercial 3'R initiatives from the Recycling Council of Ontario.

#49 PARKING LOT

This segment was not part of the Zero Waste program but you might find it interesting. You are looking at the parking lot next to 2 Fieldway Road. Quotes to repave the lot were in the range of $400-550,000. It was suggested maybe Facilities Management should look at ....

*50 LOT CLOSE-UP

Recycled asphalt and they did. This same lot was paved in recycled asphalt, the material taken off of highways, and piled sky-high. No additional drainage was required since recycled asphalt is porous and percolates the water well. It had its first winter - the results are excellent. No ponding, so no safety hazard. This lot was done for $95,000 saving Bell almost 1/2 million dollars. Recycled asphalt however, is not recommended for heavy traffic lanes. Those should be repaved with asphalt.

*51 ZERO WASTE

There are a lot of buildings out there just like 2 Fieldway Rd. The Zero Waste program is not rocket science and is easy to install. If you would install something in your building --

...IT WOULD MEAN THE WORLD TO US..............

SESSION III – POLLUTION PREVENTION

Moderator: Anton Davies, Past Chairman
Air and Waste Management
Association, Toronto

Jim Smith, Assistant Director,
Hazardous Contaminants Branch,
Environment Ontario, Toronto

Burkhard Mausberg, Researcher,
Pollution Probe,
Toronto, Ontario

Dianne Saxe, Barrister & Solicitor,
Doctor of Jurisprudence,
Toronto, Ontario

Susan Hazen, Office of
Pollution Prevention, U.S.
Environmental Protection Agency,
Washington, D C

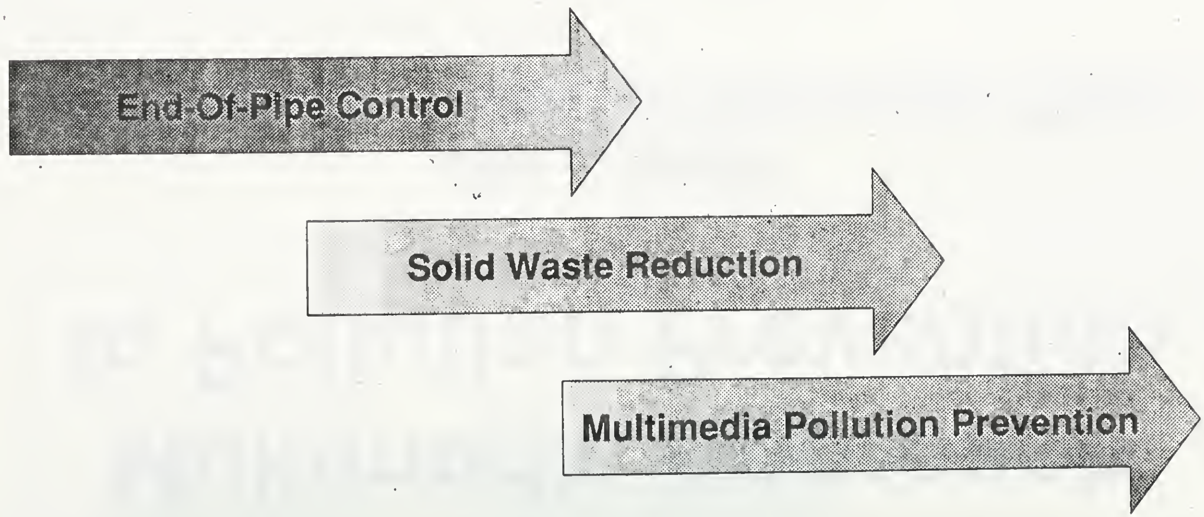
Jim Ashman, Director,
Water Resources Branch,
Environment Ontario, Toronto

Multimedia Approach to Pollution Prevention

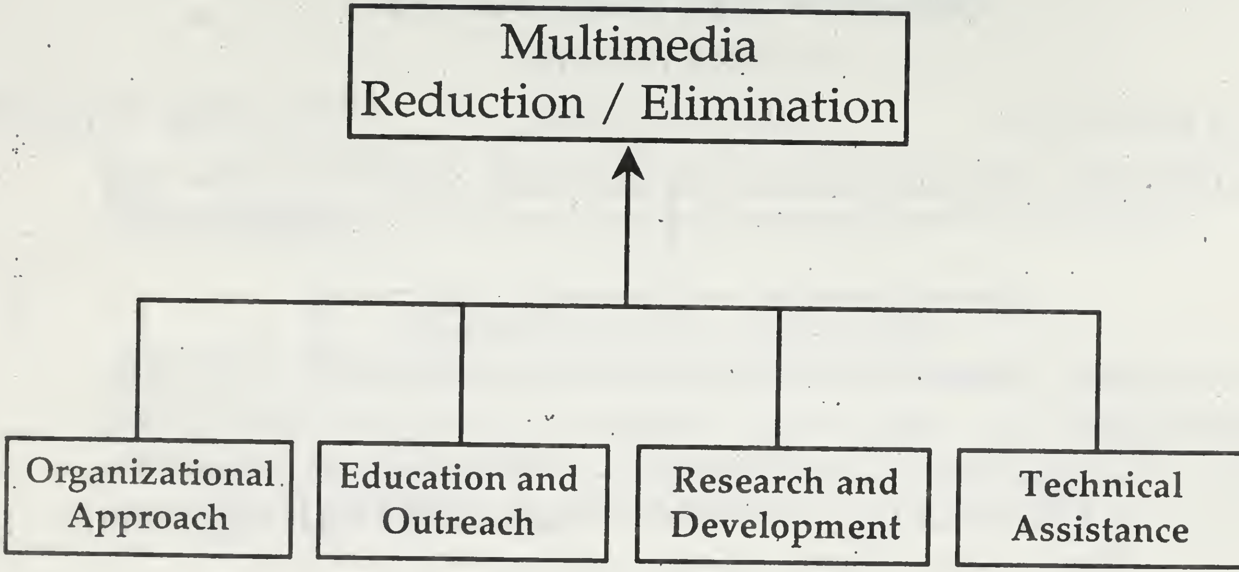
Jim J. Smith
Coordinator, Pollution Prevention Office

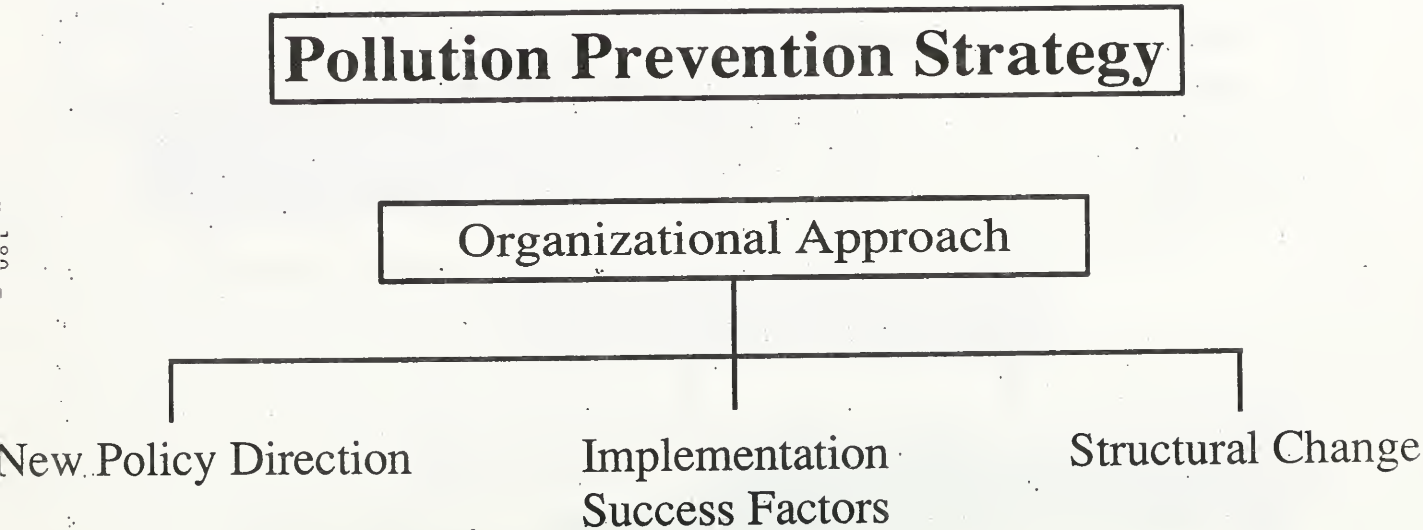
Environment Ontario

A Shift In Direction



Pollution Prevention Strategy




Pollution Prevention Strategy
Organizational Approach
New Policy Direction
Implementation Success Factors
Structural Change

POLLUTION PREVENTION

ANY ACTION WHICH *REDUCES OR ELIMINATES THE CREATION OF POLLUTANTS*

ACHIEVED THROUGH ACTIVITIES WHICH PROMOTE, ENCOURAGE OR REQUIRE CHANGES IN BASIC OPERATIONAL OR BEHAVIOURAL PATTERNS OF INDUSTRIAL, COMMERCIAL, INSTITUTIONAL, OR INDIVIDUAL GENERATORS

POLLUTION PREVENTION

IS ACHIEVED BY:

→ RAW MATERIAL SUBSTITUTION

→ PRODUCT REFORMULATION

→ PROCESS REDESIGN OR MODIFICATION

→ IN PROCESS RECYCLING

→ IMPROVED MAINTENANCE AND OPERATIONS

POLLUTION PREVENTION DOES NOT INCLUDE:

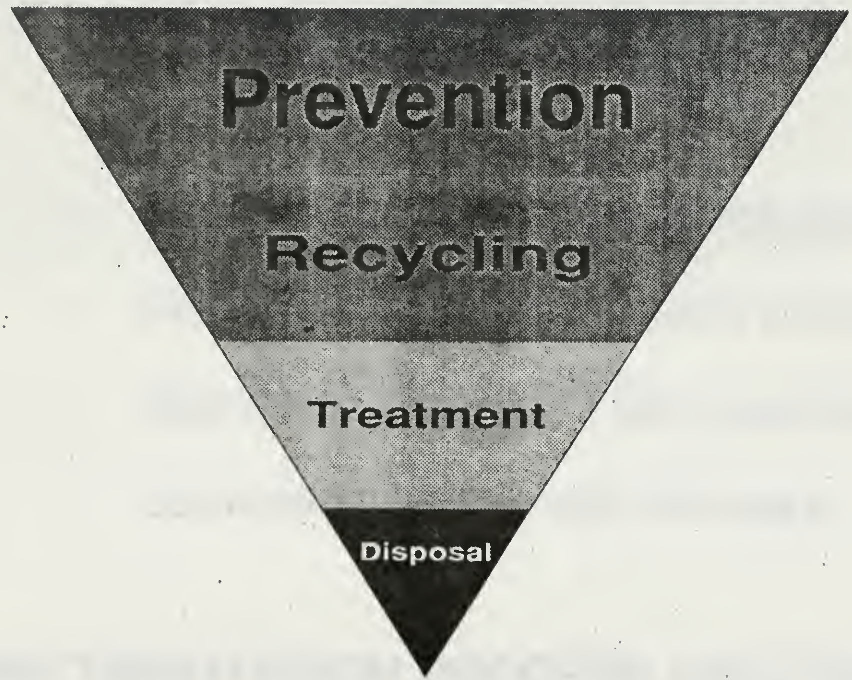
- ∅ SUBSTITUTION OF ONE TOXIC SUBSTANCE FOR ANOTHER
- ∅ TREATMENT, RECYCLING OR INCINERATION
- ∅ TRANSFER FROM ONE MEDIUM TO ANOTHER

Positioning Prevention

1. Central Part of MOE's Mission

2. First Priority in Managing Pollution

Pollution Management Hierarchy



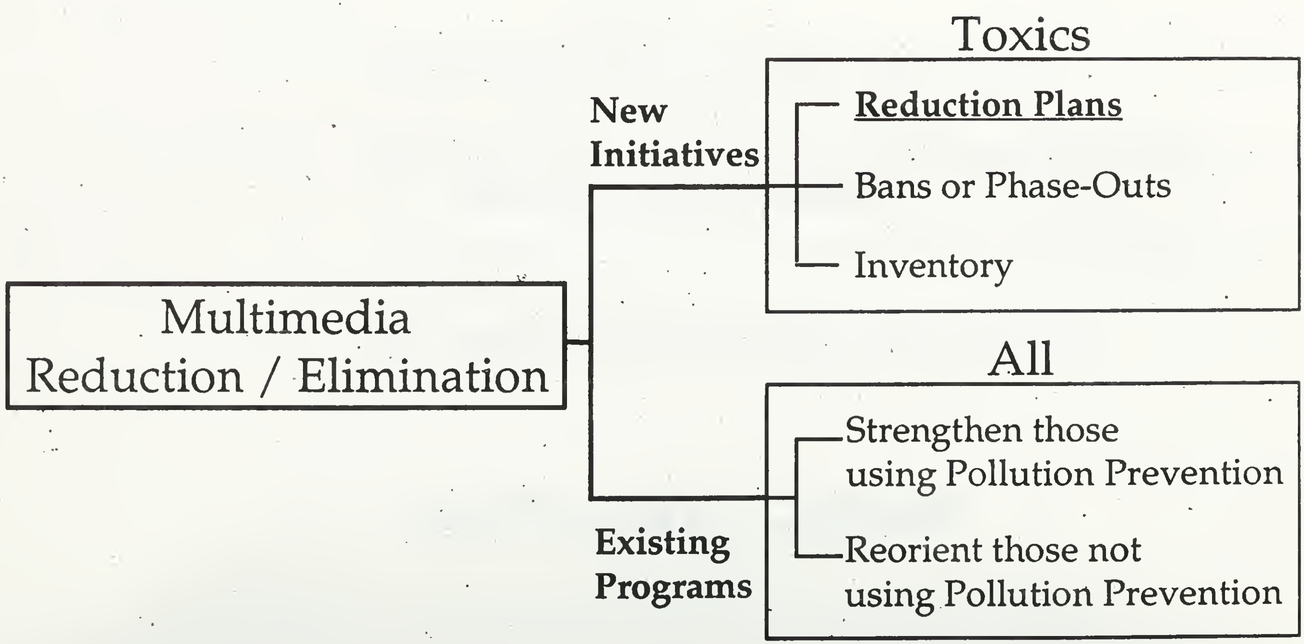
IMPLEMENTATION SUCCESS FACTORS

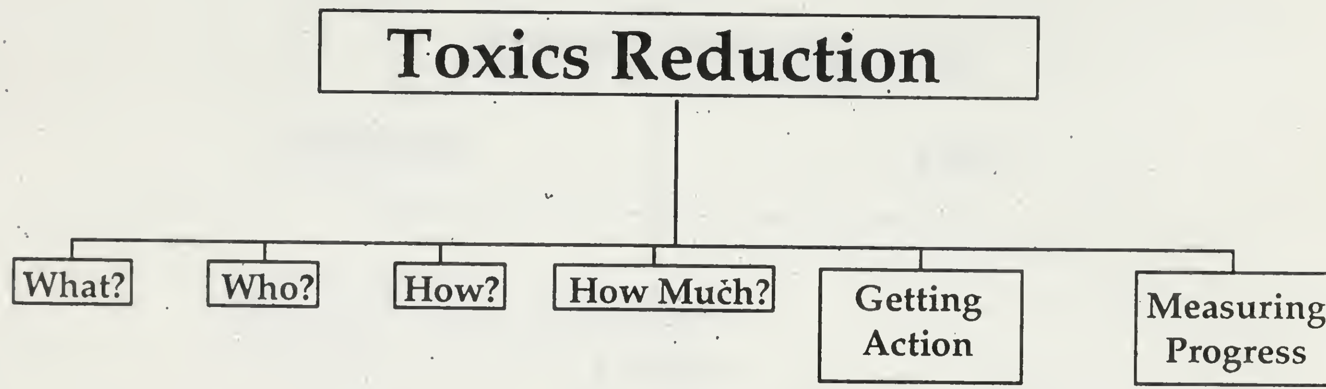
- ECONOMIC BENEFITS AND LINKAGES
- NEW MIX OF INCENTIVES AND DISINCENTIVES
- PARTNERSHIPS AND STRATEGIC ALLIANCES
- INTEGRATE WITH EXISTING FRAMEWORK

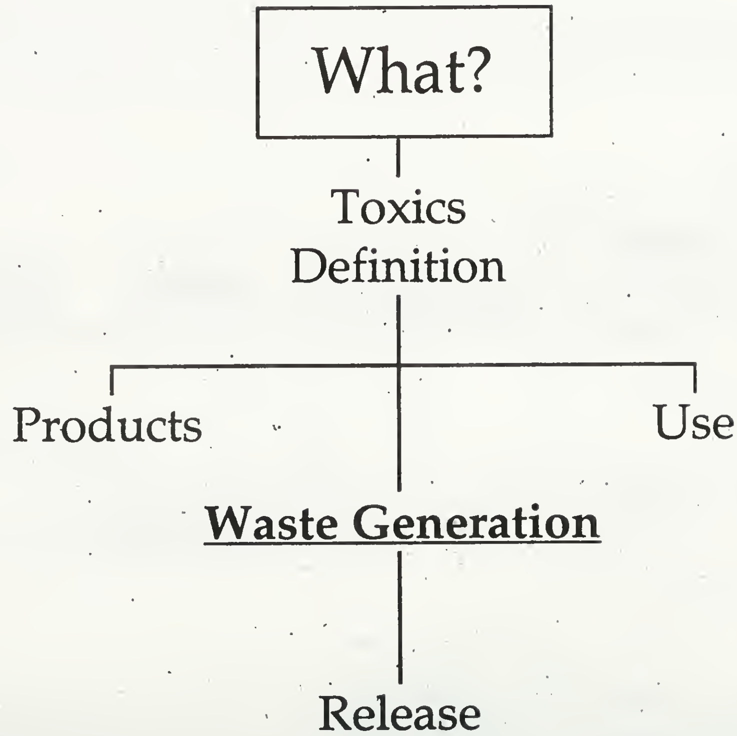
STRUCTURAL CHANGE

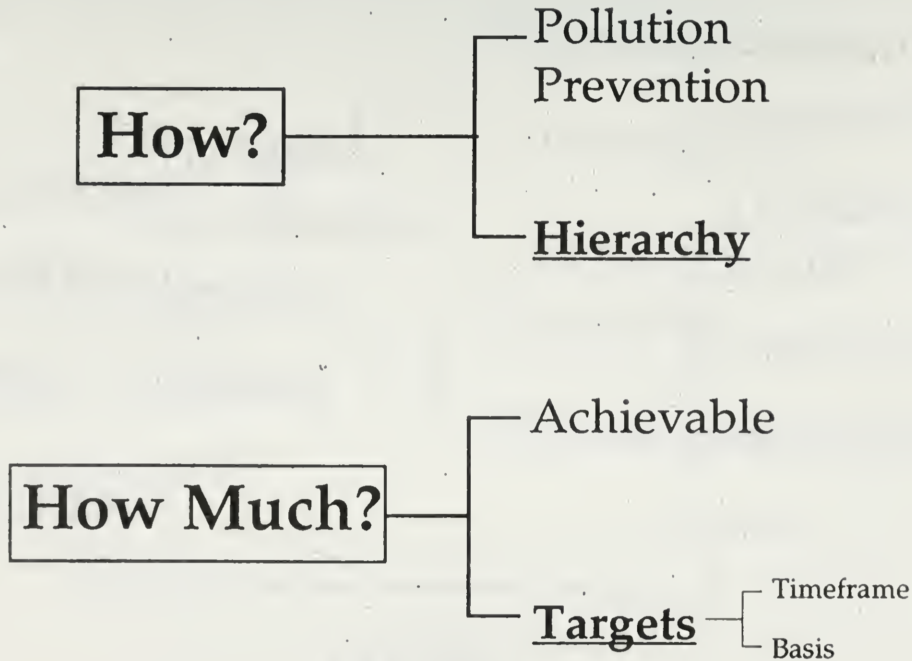
- POLLUTION PREVENTION OFFICE
- MATRIX MANAGEMENT

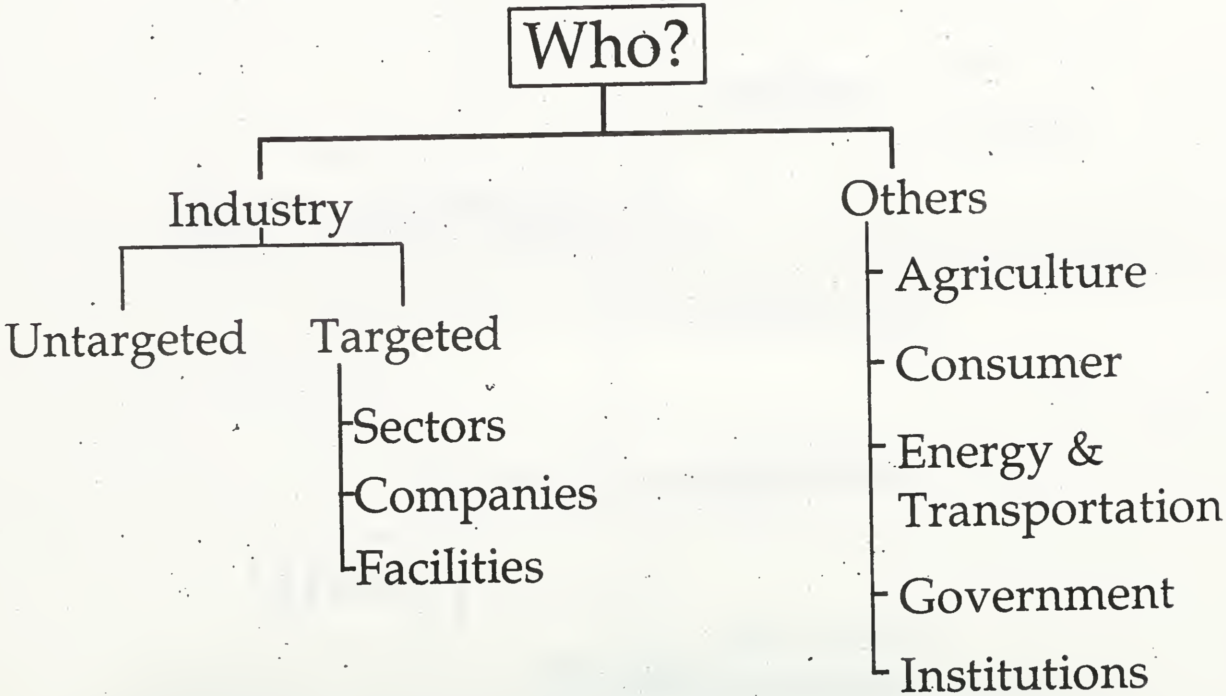
Pollution Prevention Strategy

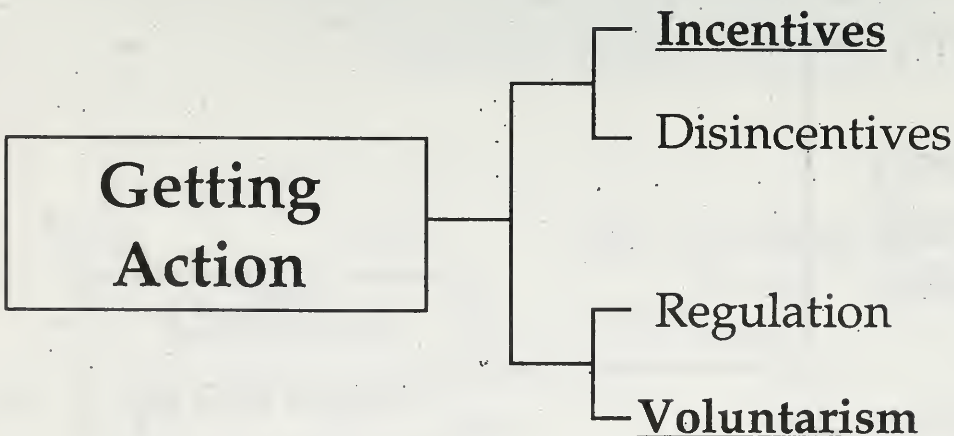


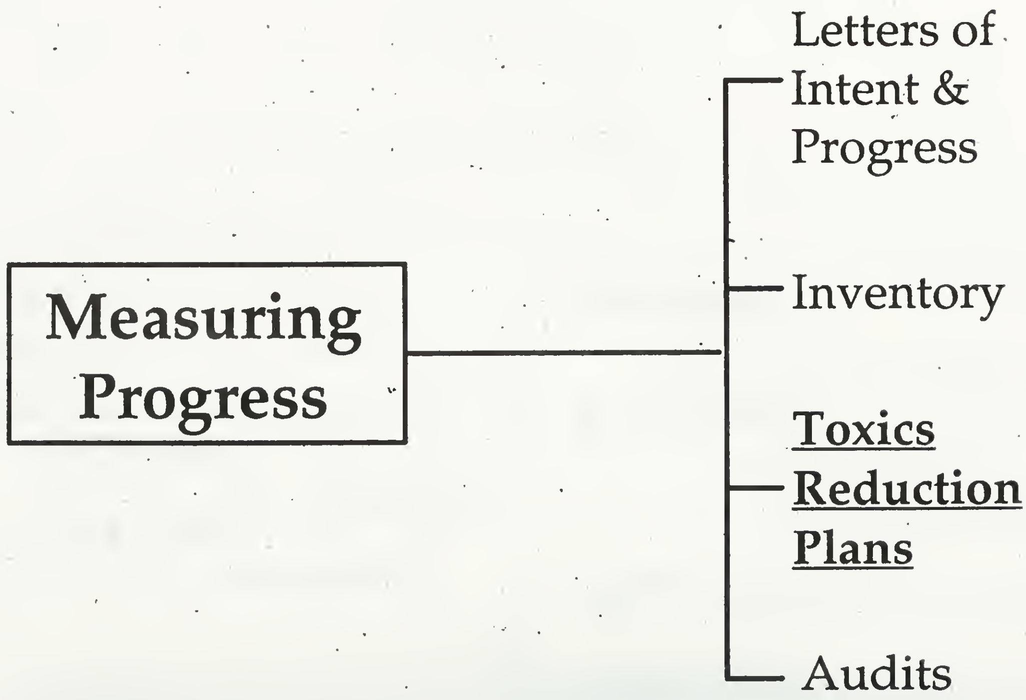

Toxics Reduction
What?
Who?
How?
How Much?
Getting Action
Measuring Progress

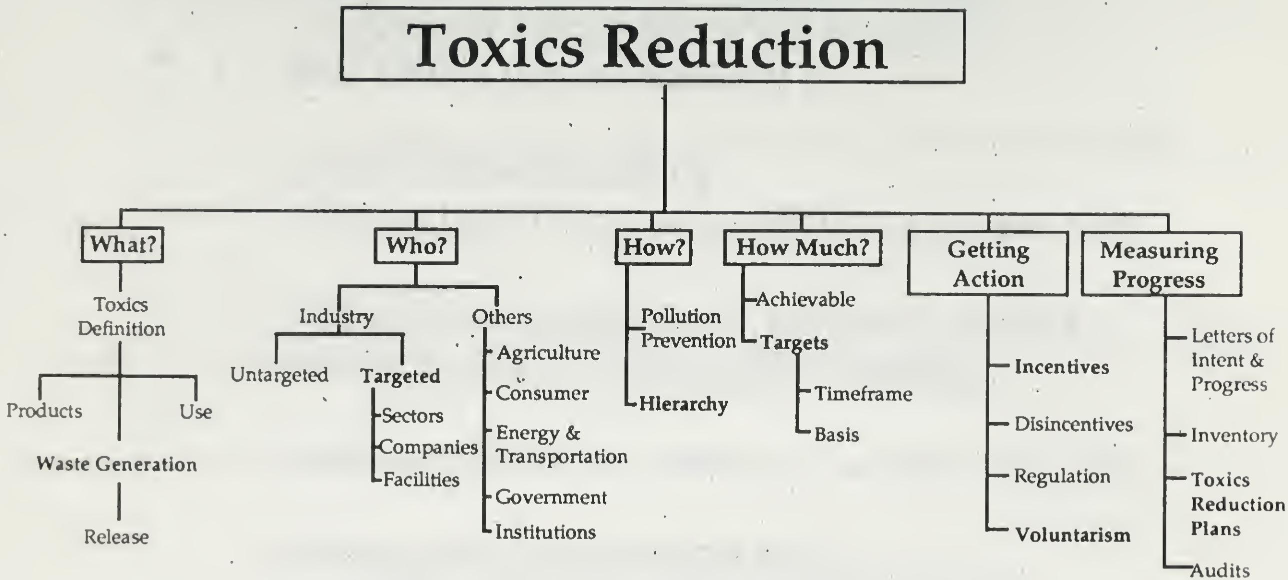

What?
Toxics
Definition
Products
Use
Waste Generation
Release


How?
Pollution Prevention
Hierarchy
How Much?
Achievable
Targets
Timeframe
Basis


Who?
Industry
Untargeted
Targeted
Sectors
Companies
Facilities
Others
Agriculture
Consumer
Energy &
Transportation
Government
Institutions


Getting Action
Incentives
Disincentives
Regulation
Voluntarism


Measuring Progress
Letters of Intent & Progress
Inventory
Toxics Reduction Plans
Audits


Toxics Reduction
What?
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Measuring Progress
Letters of Intent & Progress
Inventory
Toxics Reduction Plans
Audits

TOXICS REDUCTION PLANS

- POLICY STATEMENT AND GOALS SUPPORTING REDUCTION/ELIMINATION (R/E)
- IDENTIFICATION OF PRIORITY TOXICS FOR R/E
- DESCRIPTION OF PROCESSES WHICH USE/GENERATE/RELEASE PRIORITY TOXICS
- EVALUATION OF OPPORTUNITIES FOR R/E AND SELECTION RATIONALE
- IMPLEMENTATION SCHEDULE
- PROGRESS REPORTS, VERIFIABLE R/E

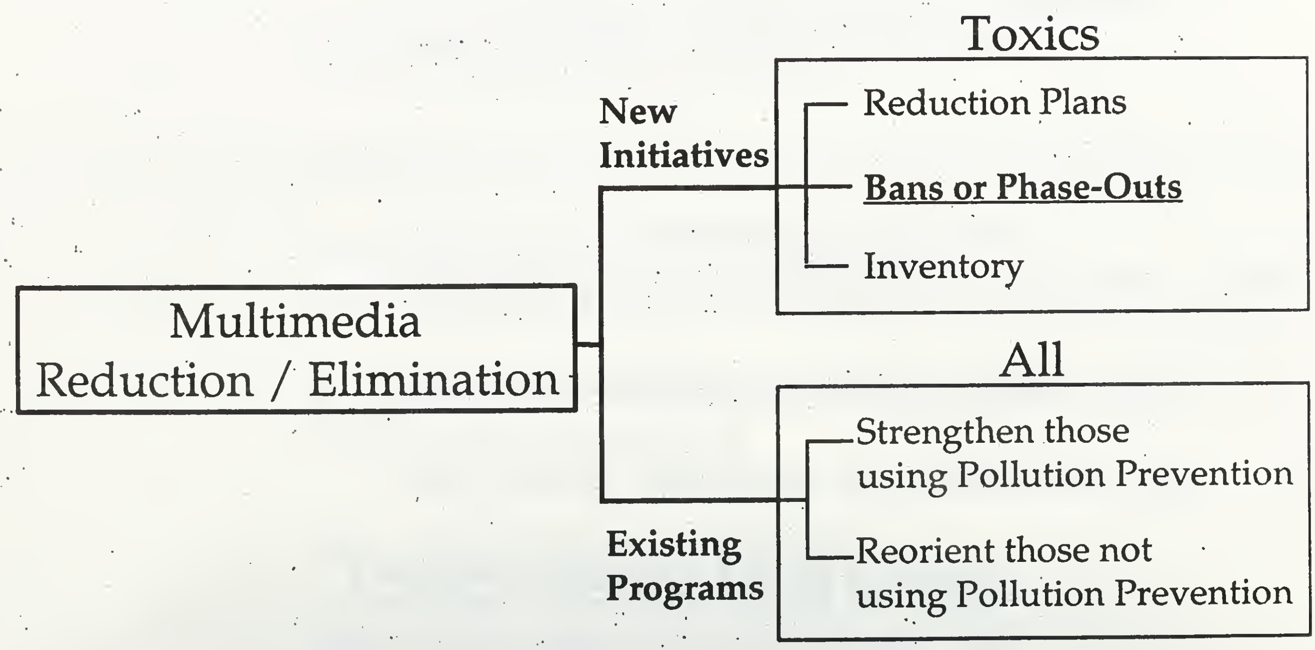
- THE FUTURE -

TOXICS REDUCTION PLANS

- CHALLENGE INDUSTRY TO DEVELOP PLANS
- DEVELOP THROUGH PARTNERSHIPS
- LINK TO BUSINESS PLANNING CYCLE AND TOTAL QUALITY MANAGEMENT PROGRAM

- FIRST PROJECT AND PARTNERSHIP - CHRYSLER, FORD, GM, MVMA, ENVIRONMENT ONTARIO, AND ENVIRONMENT CANADA

Pollution Prevention Strategy

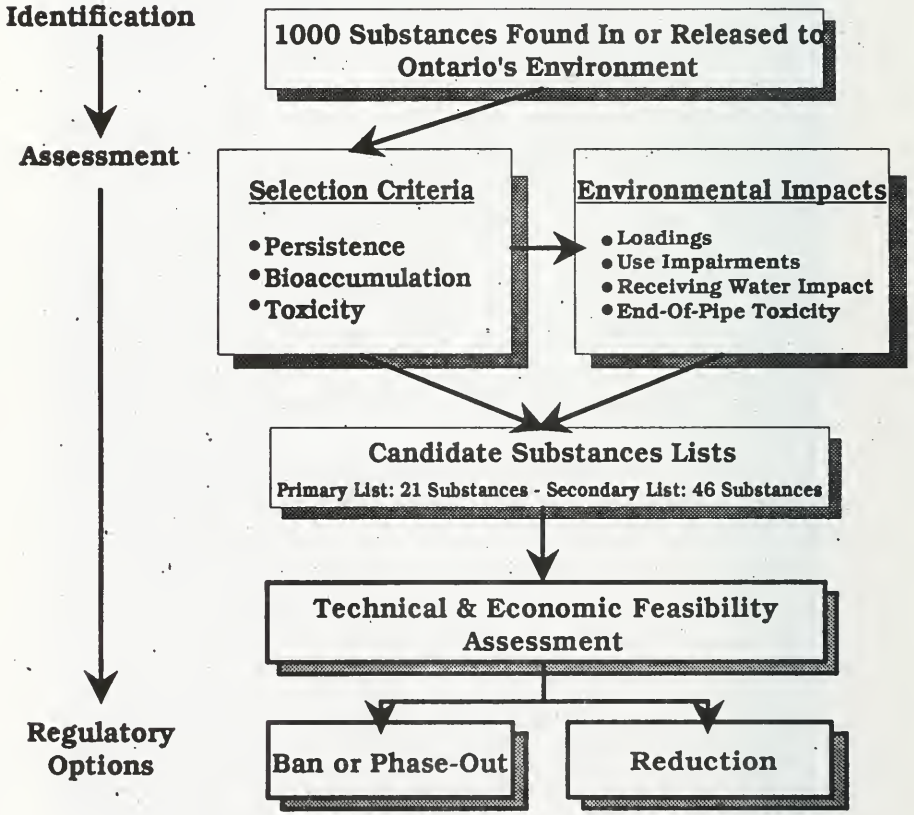


Candidate Substances List For Bans or Phase-Outs

April 1992

Environment
Environnement
Ontario

Selection of Candidate Substances for Bans or Phase-Outs



Hexachlorobenzene

Effect	Data Value	Score
Persistence		
Soil	**T1/2 4 years**	**10**
Water	T1/2 41 hours (volatilization)	0
Sediment	**no degradation**	**10**
Air	**T1/2 2 years (photooxidation)**	**10**
Bioaccumulation	**fathead minnow BCF 35,000**	**10**
Acute Lethality		
Oral	rat LD50 1250 mg/kg	2
Inhalation	cat LC50 1600 mg/m3	2
Dermal	no data	*
Aquatic	largemouth bass LC50 12 mg/L	4
Chronic/Subchronic Toxicity		
Terrestrial Nonmammal	quail NOAEL 0.1 mg/kg/day	8
Aquatic	daphnia repro. NOAEL 0.016 mg/L	6
Mammal Oral	**rat liver NOAEL 0.05 mg/kg/day**	**10**
Mammal Inhalation	no data	*
Aquatic Plant	algae EC50	8
Terrestrial Plant	no data	*
Teratogenicity	rat oral 19 mg/kg/day, developmental anomalies	6
Carcinogenicity	**animal carcinogen, possible human carcinogen, IARC Group 2B classification**	**10**

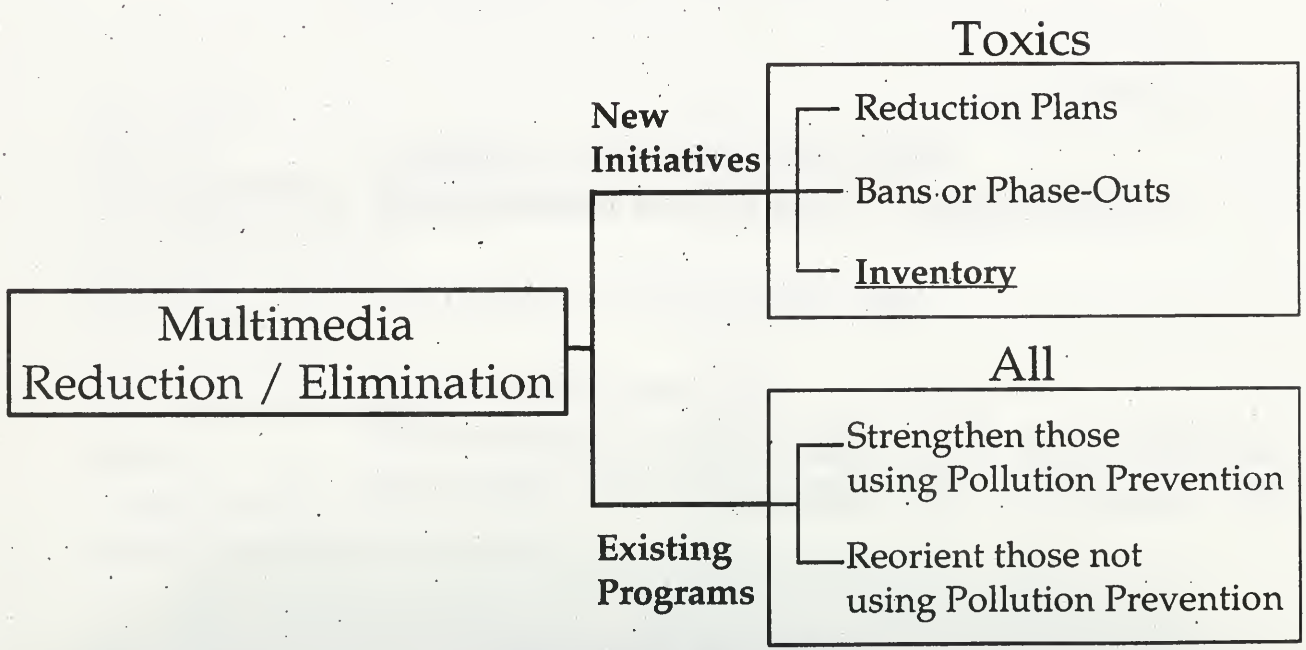
ONTARIO'S PRIMARY CANDIDATE SUBSTANCES LIST FOR BANS OR PHASE-OUTS

anthracene
arsenic
benzo[a]pyrene
benzo[ghi]perylene
benz[a]anthracene
DDT/DDD/DDE
1,4-dichlorobenzene
3,3'-dichlorobenzidine
dieldrin
hexachlorobenzene
alpha-hexachlorocyclohexane
gamma-hexachlorocyclohexane
mercury
mirex
pentachlorophenol
perylene
phenanthrene
PCBs
PCDDs & PCDFs
toxaphene
tributyl tin

FUTURE ACTION

- NATIONAL MULTISTAKEHOLDER COMMITTEE FOR ACCELERATED REDUCTION OR ELIMINATION OF TOXIC SUBSTANCES
- ONTARIO IS A STAKEHOLDER
- DEVELOPING FAST TRACK APPROACH AND OVERALL NATIONAL PROCESS

Pollution Prevention Strategy



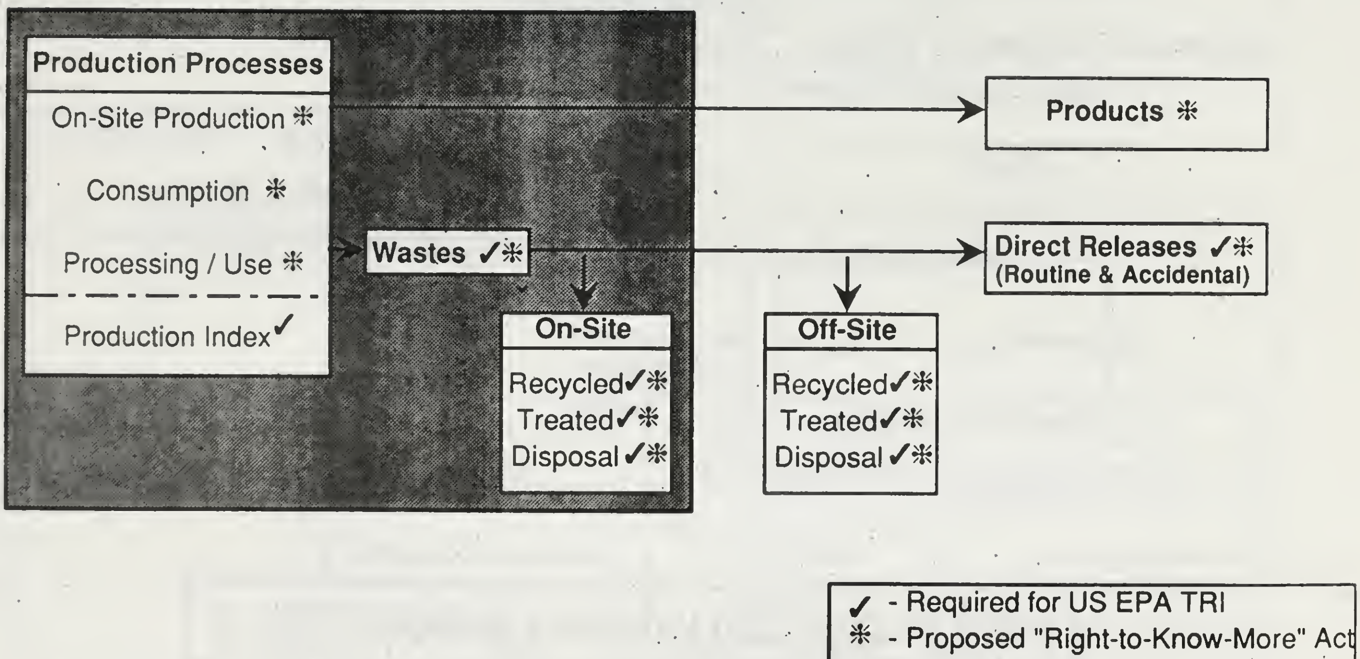
MULTIMEDIA POLLUTANTS INVENTORY

- PROVIDES ESTIMATES OF QUANTITIES OF SPECIFIED POLLUTANTS USED, GENERATED AND RELEASED IN ONTARIO ON A FACILITY BASIS
- MEASURES PROGRESS IN REDUCING OR ELIMINATING SPECIFIED POLLUTANTS
- INFORMATION AVAILABLE TO THE PUBLIC
- IDENTIFIES PRIORITIES FOR FUTURE ACTION

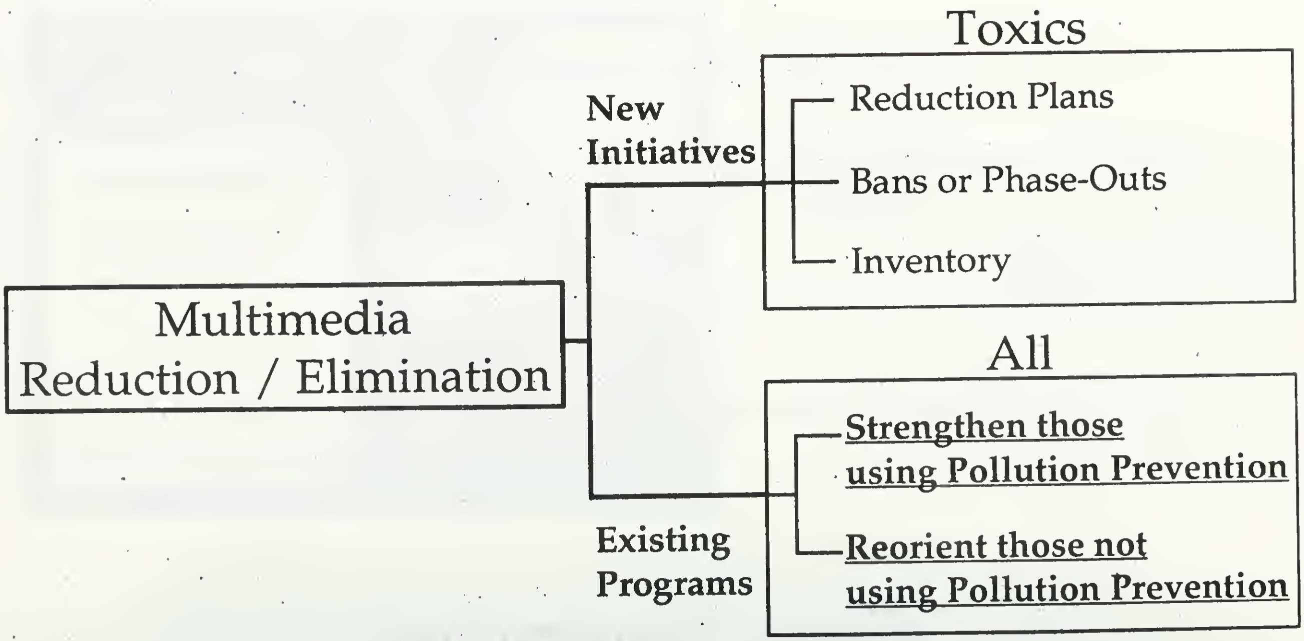
NATIONAL POLLUTANTS RELEASE INVENTORY

- ENVIRONMENT CANADA LEAD
- MULTI-STAKEHOLDER COMMITTEE TO DEFINE FRAMEWORK
- US TRI AND CCPA NERM USED AS MODELS
- MOE PARTICIPATES AS STAKEHOLDER

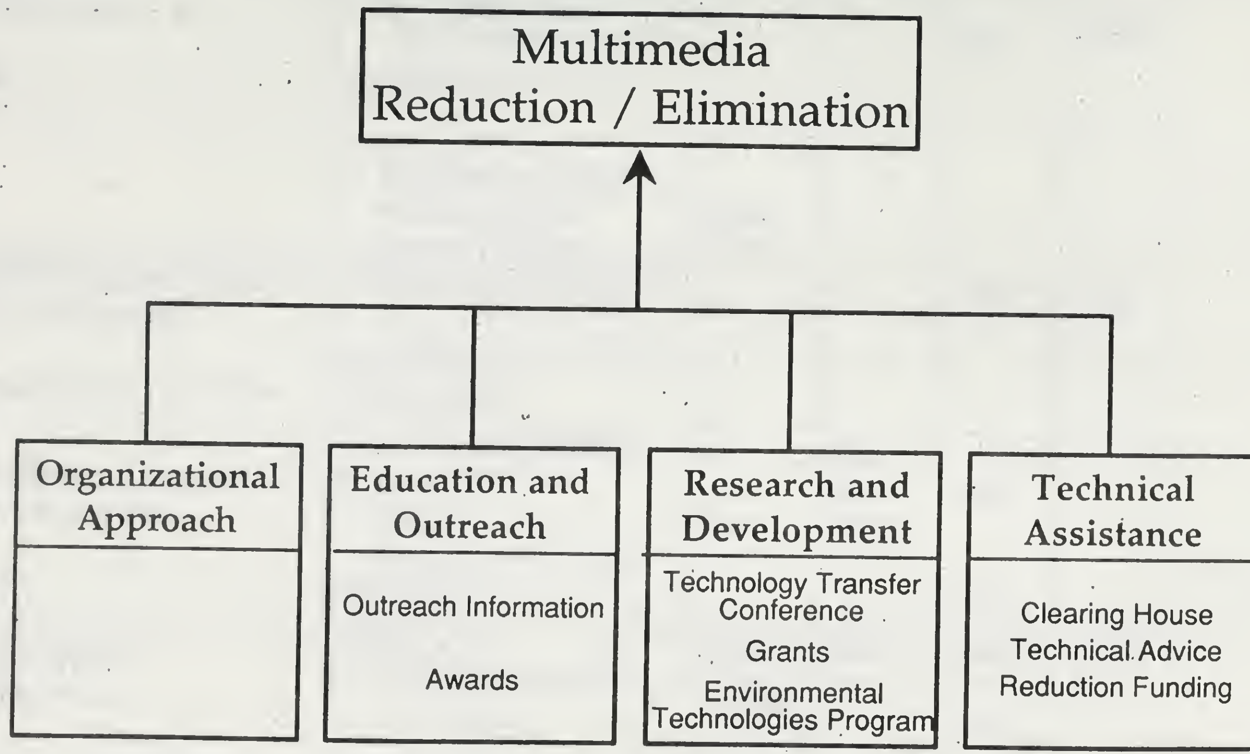
Multimedia Toxics Inventory Information Needs



Pollution Prevention Strategy



Pollution Prevention Strategy



U.S. INDUSTRY GOALS IN POLLUTION PREVENTION

COMPANY PROGRAM	GOAL				
	YEAR	91/92	93/94	1995	2000
AT&T	REDUCE				
Environmental Program	• CFC	50%	100%		
	• Air Emission		50%	95%	
	• Process Waste		25%		
Northrop B-2 Division	REDUCE or ELIMINATE				
Zero Discharge Pollution Prevention	• Waste Disposal			25%	50%
	• Water Usage	20%			
	• Air Emission	25%			
	• Eliminate ODC's		✓		
3M	REDUCE				
3P Program	• All Releases				90%
Pollution Prevention Pays	• Hazardous Waste Generation				
	• Achieve Zero Emissions				

CANADIAN INDUSTRY GOALS IN POLLUTION REDUCTION

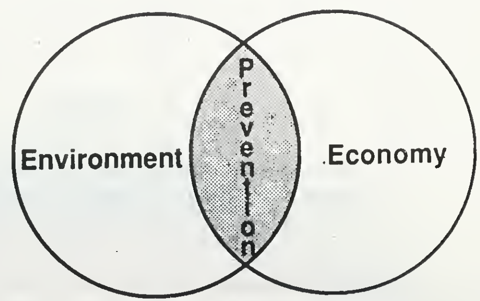
COMPANY	GOALS					
	YEAR	91/92	93/94	1995	1996	2000
DOW	REDUCE • Hydrocarbon and NOx Emissions			50%		
	ELIMINATE • Spills and Harmful Discharges *					✓
NORTHERN TELECOM	REDUCE/ELIMINATE • CFC Solvent Use	✓				
	• Methylchloroform		✓			
DU PONT	ELIMINATE • CFC Production			✓		
NORANDA MINERALS	REDUCE • SO_2 Emissions *		20%			
	• Metal Emissions *					90%
	• Energy Consump.			10%		
MONSANTO	REDUCE • Haz. Air Emission	90%				
	• All Waste			70%		
ESSO CHEMICAL	REDUCE • Emissions/Waste				50%	

NOTE: * Plant Specific Goals

Benefits

- Partnerships result in more creative and cost effective approaches

- Improved competitiveness
  - Focuses effort on fundamental production processes rather than on non-value-added treatment systems
  - Reduces both cost and liabilities associated with traditional pollution management



SUNSETTING HAZARDOUS CHEMICALS

by
Burkhard Mausberg, Researcher,
Pollution Probe, Toronto,
Ontario

"It appears that the only chemicals to have declined significantly in the Great Lakes ecosystem are those whose production and use have been prohibited outright or severely restricted."

– U.S. Council on Environmental Quality[1]

What Is Sunsetting?

In its recent *Sixth Biennial Report*, the International Joint Commission (IJC) provided an excellent definition of sunsetting:

> "'Sunsetting' is a comprehensive process to restrict, phase-out and eventually ban the manufacture, generation, use, transport, storage, discharge and disposal of a persistent toxic substance. Sunsetting may require consideration of the manufacturing processes and products associated with a chemical's production and use, as well as the chemical itself, and realistic yet finite time frames to achieve the virtual elimination of the persistent toxic substance."[2]

The emphasis of sunsetting is on *complete* and *comprehensive* elimination. That is, it includes phase-outs of *uses, generation and releases*, and it does not imply a case by case approach, but focuses on examining *all* substances and deciding which ones should be eliminated.

Of course, the initial focus is on those substances that are the most hazardous, and in this regard Pollution Probe defines substances to be hazardous if they are toxic and persistent and/or bioaccumulative.

Historical Overview Of Sunsetting

The term sunset was coined by Bo Wahlstrom of Sweden's National Chemicals Inspectorate. In 1989, at the 13th joint meeting of the OECD chemicals group, Sweden proposed the development of a global sunset list, consisting of chemicals that should be phased-out and banned globally. The OECD Chemicals Group was reluctant to embrace the Swedish proposal, and the sunset concept is now hidden somewhere in the OECD's risk reduction project.

In early 1991, the Canadian Institute for Environmental Law and Policy, together with the U.S. NWF, released the report, *A Prescription for Healthy Great Lakes*. This document was the result of two years of research into implementing the zero discharge goal of the Great Lakes Water Quality Agreement. One of the three main recommendations included the development of a Sunset Chemicals Process for the Great Lakes.

Also in 1991, the New Directions Group, a consortium of the CEO's of Canada's largest industries, environmental groups and research institutes, issued an action plan for toxic chemicals, which included the recognition that a sunset chemical protocol is required for Canada. In 1992, the *Sixth Biennial Report* of the International Joint Commission also contained strong recommendations for a sunset chemicals protocol. Finally, in April of this year, the Ontario Ministry of the Environment issued its lists of 21 primary and 46 secondary sunset candidates.

Thus, given the relatively short life of the sunset concept, it has gained considerable support from industry, government and environmental groups.

Why Is Sunsetting Necessary?

Ecological and Human Health Impacts

First, and in Pollution Probe's view the most important aspect, is ecological need. In the Great Lakes Basin, wildlife, fish and human health are being affected by persistent, toxic and bioaccumulative substances. This is also occurring in other ecosystems.

The effects have been well documented for several years. Traditionally, the concerns have focused on the most blatant and acute effects. In recent years, however, a wealth of evidence has been collected which suggests that the impacts of persistent toxins have been more insidious. The book, Great Lakes, Great Legacy, produced by the U.S. Conservation Foundation and the Institute for Research on Public Policy has documented the wide range of insidious, sublethal damage to fish and wildlife which has been caused primarily by persistent toxic substances.

Even though industries and governments have spent billions of dollars on reducing persistent toxins in the last two decades, the ecological and human health impacts are still occurring. Thus, Pollution Probe believes that a sunset chemicals protocol is now required.

Costs of Clean-ups

In the Great Lakes, there are now 43 Areas of Concerns which are developing Remedial Action Plans. A complete financial analysis of how much it will cost to clean up the Areas of Concern has yet to be done. However, some government representatives are quoting anywhere between $10 and $15 billion dollars for all RAPs. A large part of the clean-up costs is associated with contamination caused by persistent toxins: contaminated sediments are a good example. One also should examine the costs of destroying existing stocks of persistent toxins; for example, PCBs. One also might consider costs associated with health care and costs associated with productivity losses due to the health impacts of persistent toxins.

A Sunset Chemicals Process will prevent similar contamination in the future, and will save the costs associated with persistent toxic substances. While banning substances will incur costs on society, in the long run, Pollution Probe believes a sunset protocol will save financial resources.

Failure of the End-of-the-Pipe Approach

The traditional end-of-the-pipe focus for pollution control has failed. Most participants in the environmental field have recognized that pollution prevention is superior to pollution control. The Sunset Chemicals Process represents the ultimate pollution prevention strategy.

Sunsetting Fulfils Government Promises

The federal government signed the Great Lakes Water Quality Agreement in 1978 which calls for the virtual elimination of persistent toxic substances. The federal Green Plan extends this promise to the whole country. Sunsetting satisfies the partial fulfilment of these promises.

Successes of Previous Sunsets

Banning achieves success in pollution levels. Barry Commoner has documented this success:

Table 1. Improvements* in U.S. Pollution Levels.[3]

Pollutant	Time Period	Percent Change	Control Measure
lead emissions	1975-1985	-86%	removed from gasoline
DDT in body fat	1970-1983	-79%	agricultural use banned
PCBs in body fat	1970-1980	-75%	production banned
mercury in sediments	1970-1979	-80%	replaced in chlorine production

<u>Summary</u>

In summary, a sunset chemicals process is required because:

* of continued ecological and human health damage,
* of the costs of clean-ups,
* of the failure of the end-of-the-pipe approach,
* it fulfils requirements of the GLWQA and the Green Plan, and
* of previous successes of phase-outs.

How Should a Sunset Chemicals Process be Designed?

The central part of a sunset chemicals process is a screening system, consisting of scientific criteria, to determine which substances have to be sunsetted. Pollution Probe is working with the George Washington University to develop such a system. It is similar, but different, to the system developed by the Ontario Ministry of the Environment. The criteria we are examining include persistence, bioaccumulation, acute and chronic toxicity, cancer, developmental toxicity and others.

Several chemical lists of substances will be put through the screening system to develop a sunset chemicals list for the Great Lakes. Once the list is available, the

---

* Lead is measured in amount emitted per year, while DDT and PCBs are measured as concentrations. The PCB values refer to a change in percentage of people with PCB body fat levels greater than 3 ppm.

work continues in two ways. First, the criteria system should be updated periodically as new substances will likely enter the sunset realm. And second, Pollution Probe would like to see the screening system applied to all new chemicals. This has been termed the "sunrise" process, which will not allow new hazardous substances to be generated, used or released.

Following the development of the criteria system, an implementation system needs to be established. Those substances that have alternatives available should be banned and phased-out first. For the remainder, time-tables and schedules have to be set for sector-by-sector phase-outs. In addition, there is also a need to examine processes and products. For example, certain processes may create sunset chemicals as by-products or by accident. PAHs in aluminum smelting, or organochlorines in kraft pulp and paper plants are good examples. In these cases, the processes have to be sunsetted.

Sunsetting in the Broader Picture

In an industrial society, several very basic activities occur that will ultimately cause persistent toxic substances. For example, burning coal turns out to be one of the largest anthropogenic source of mercury, which is a sunset candidate under the Ontario list. Given that coal burning also produces acid rain, greenhouse gases, other persistent toxins and that coal burning kills miners in Nova Scotia, maybe it is time to sunset the use of coal.

Another fundamental process is the splitting of salt to produce chlorine. As long as elemental chlorine is produced, organochlorines will be produced, and many of these chemicals have turned out to be persistent toxins. The ultimate pollution prevention activity would be to phase-out the use of chlorine as an industrial feedstock. Indeed, this was recommended by the International Joint Commission recently.[4]

Therefore, sunsetting must set the path towards eliminating those processes which will eventually produce persistent toxic substances. The establishment of a criteria-based screening system is a good start in this direction.

> **"In the end, what we as a society refuse to destroy will define us as much as what we decide to create."[5]**

Notes

1. The U.S. Council on Environmental Quality, 1990. Environmental Quality: Twentieth Annual Report, Executive Office of the President, page 363.

2. International Joint Commission, 1991. Sixth Biennial Report on Great Lakes Water Quality, Ottawa, Ontario, page 25.

3. Data taken from: Barry Commoner, 1988. "Failure of the Environmental Effort", Environmental Law Reporter, Vol. 18, June 1988, page 10197.

4. International Joint Commission, 1991. Sixth Biennial Report on Great Lakes Water Quality, Ottawa, Ontario, page 30.

5. Steve McCormick, The Nature Conservancy, quoted in "Managing Earth's Resources", special section in Business Week, June 18 1990, page 1.

INTEGRATING THE NEW REGULATORY REQUIREMENTS INTO A CORPORATE GREEN PLAN

by

Dianne Saxe, D. Jur.

Toronto, Ontario

What is a green plan

A "green plan" is a structure for shifting the focus and the scope of corporate management to integrate environmental considerations with practical economic decision making, especially through understanding, applying, and anticipating legal requirements.

Why do you need one?

Today, environmental regulation and liabilities are more and more pervasive. They can affect almost every business in one way or another, whether large or small, manufacturing or service sectors. They affect the land you buy or rent; the money you lend, borrow or invest; what you tell your shareholders; the electricity you use; the products and services you produce, the way you produce them; the way you package and sell them; and how you dispose of your wastes. They have an increasing impact on public image and market share. Delays in obtaining approvals, or uneven regulation by government, can threatened the viability of many businesses.

Environmental liabilities are concerns not merely for the corporation as a whole, but also for all the individuals who work there. There is no "corporate veil" for environmental liabilities.

Environmental liabilities are also more and more expensive. Prosecutions have increased from 54 a year to thousands. Fines which 8 years ago averaged several hundred dollars are now often in the hundreds of thousands of dollars. Cleanup costs can add millions to the cost of shutting or moving a plant, or of buying or selling property, or even of losing a tenant. Their financial impact is growing steadily.

For these reasons, avoiding prosecution, and mounting a successful defence when charges are laid, are increasingly good investments of corporate time and money. This is not a simple matter of compliance with set standards. It requires an active program of environmental due diligence which is thorough, well-thought-out, coherent and vigorously implemented.

The traditional focus of corporate management has been on internal matters such as the famous "bottom line". Environmental liabilities were often ignored, or were safely pigeon-holed as the responsibility of an "environmental manager" or department. Some progressive companies then commissioned an environmental audit; some followed it up, others did not. This type of approach isn't good enough. It won't give a company the protection it needs to minimize environmental problems, nor to show a court due diligence if a problem occurs. In addition, such a company will be poorly positioned to compete in today's marketplace, or tomorrow's.

A structured approach to incorporating environmental concerns in management decisions can have substantial advantages:

The company may be able to avoid the acquisition of expensive environmental problems created by others.

The company may be able to identify new business opportunities.

The company may be able to improve relations with its customers, employees, shareholders and neighbours.

The company may be able to establish a good track record and credibility with regulators.

Audits of material use, of energy, and of waste frequently identify areas where businesses can cut costs by becoming more efficient.

A "green plan" may enhance a company's ability to obtain bank financing, to launch a stock issue, or to obtain environmental impairment insurance.

Lenders, insurance companies and underwriters are becoming intensely aware of their potential exposure should they deal with companies with serious environmental problems.

The entire effort will pay for itself if one significant spill or offence is averted, by alerting the company to potential accidents before they happen or while they are still small enough to be easily controlled. Spills cost enormous amounts in time, money, lawyers and adverse publicity.

Where does Bill 143 fit in?

Bill 143 is another step in the development of a regulatory agenda which will continue to push Canadian businesses towards sustainable development. The key focus in this Bill is on waste reduction. To date, Canadians have been among the most wasteful people in the world. We have become accustomed to huge consumption of energy, of space, of air and water, and of material goods such as paper and plastic, to a degree which amazes and appalls much of the rest of the world. We will not be allowed to continue indefinitely. If we wish to protect our privileged standards of living, we will be forced to learn to do much more with less. We did not do enough voluntarily; now the government is starting to make us.

The first elements of Bill 143 to have practical effect for most private companies will be:

> the new waste management rules for the ICI sector: waste auditing, source separation, and waste reduction workplans;
>
> packaging reductions, (a first step towards product stewardship)
>
> reduction and elimination of "problem products".

Each of these are predictable components of an overall emphasis on sustainable development, and on reducing Canada's pattern of excess consumption and excess waste. They are consistent with a systematic approach to integrating environmental concerns with business decision - making. They should not be viewed in isolation.

The basic components of a green plan

General principles for successful design of a green plan

Designing a green plan should begin with a set of principles which guide your approach to the task. For a progressive company, these would probably include:

> Give environmental concerns the priority they deserve. Make environmental matters part of the main business of your line managers.
>
> Understand what environmental law requires, now and in the foreseeable future. Try to understand the goals and motivations of environmental regulators and activists.
>
> Recognize your responsibility for the problems you help to create
>
> Develop a clear sense of where your company wants (and needs) to go.
>
> Be pro-active. Don't wait until the government or someone else makes you do something. Do what you need to do, but do it on your own terms when you can keep better control of timing and cost.
>
> Turn problems into opportunities, and act on them.

A structured approach for systematically turning environmental problems into opportunities typically includes:

BILL 143 AND THE CORPORATE GREEN PLAN

A structured approach: Six Steps To A Corporate Green Plan

STEP 1: CORPORATE COMMITMENT - RESOLUTIONS OF THE BOARD
STEP 2: IDENTIFY CURRENT PROBLEMS & OPPORTUNITIES - THE ENVIRONMENTAL AUDIT
STEP 3: IDENTIFY SOLUTIONS , PREPARE ACTION PLAN
STEP 4 COMMUNICATION
STEP 5: IMPLEMENT ACTION PLAN
STEP 6: FOLLOW UP

Many of these steps will be institutionalized by the regulations to implement Bill 143.

STEP 1: Corporate commitment - Resolutions of the Board

Expanding the focus of management to include environmental protection can only succeed if it is built upon a serious corporate commitment.

Corporate commitment starts with the directors. The directors should:

a) Adopt a formal environmental policy establishing the corporation's environmental goals. At a minimum, this must include corporate commitment to full compliance with environmental laws and to preventing spills. The policy may go further and commit the company to go beyond the minimum requirements of the law. Leadership companies will commit themselves to sustainable development, and will use their utmost good faith to avoid harm to the interests of future generations.

If compliance with Bill 143 is one of the key goals of the policy, the company will want to single out the need for waste reduction to meet prescribed goals. A sample environmental policy is included at the end.

b) Require management to brief the Board on both economic and environmental impacts whenever the Board is asked to make decisions. This is a critical step, as it ensures that environmental concerns will be integrated into the decision making process, and will be brought repeatedly to the attention of directors and management.

c) Require management to develop a detailed "green plan", with budget and schedule, to achieve the corporation's environmental goals.

d) Maintain an ongoing interest in the green plan. The directors should require management to report back to the board with an action plan within a reasonable period of time, and ensure that there are sufficient resources to implement it. The directors, or a special Board committee, should review regular progress reports on the green plan.

Management should respond to these directives by undertaking Steps 2 - 5. The process returns to the directors in Step 6.

STEP 2: Identify current problems and opportunities

The first step in preparing a green plan to achieve the Board's environmental goals is to identify the corporation's environmental problems and opportunities through an environmental audit. Such audits are a thorough, systematic, formalized and properly documented review of the relevant aspects of the corporation, in comparison to its environmental goals. Audits may be focused narrowly on doing the minimum required by law ("compliance audits"), more broadly on opportunities to improve the environmental impact and positioning of the company ("leadership audits"), or something in between.

Directors should insist that audits be based upon detailed, written terms of reference that reflect a thoughtful understanding of the company's goals. Audits may be performed in-house, by consultants, or both. A team approach is often best. Consultants often bring expertise, experience and resources not available in-house, but they can rarely match company staff in their knowledge of the plant and its people and equipment. In addition, company staff are more likely to support the "green plan" process if they have had a responsible share in its development.

There are at least five types of audits: audits of ONGOING OPERATIONS, WASTE AUDITS, PRODUCT AUDITS, audits of PROPERTY CONTAMINATION (existing properties), and audits of PROPERTY ACQUISITIONS.

Audits of Ongoing operations

Operations audits have at least four key functions. The first function of an operations audit is to identify the extent to which the corporation is presently in compliance with environmental laws. In other words, does the corporation hold and comply with all applicable licenses and permits? Are corporate emissions within all legally applicable standards? Is corporate waste disposed of using properly licensed haulers and properly documented? Are all necessary reports being filed with the Government? Are all applicable orders being fully complied with?

The second function of the audit should be to systematically identify and evaluate the risk of accidents which could cause environmental damage.

The third function is to identify future problems and trends. For example, will the company remain in compliance when new regulatory initiatives are adopted?

The fourth function is to identify opportunities to become more efficient, and/or to profit from increased environmental consciousness. For example, can product flushed during line changes be recaptured instead of going for disposal?

Areas which are usually reviewed include at least:

a) Environmental policies and manuals

c) Monitoring and supervision

d) Employee training

e) Staffing levels

f) Use of independent contractors and outside experts

h) Equipment design, age and capacity

k) Maintenance

l) Emergency planning

m) Reporting and labeling

n) Security and prevention of vandalism

o) Product handling

p) Waste creation and disposal.

In performing the audits, the company must focus on a number of levels of detail. Technical "end of pipe" emission controls, a traditional focus of environmental audits, are only the first possibility. More generally, companies should assess whether the need for end of pipe controls can be avoided through upstream changes; review of waste disposal options should be accompanied by a review of options for waste reduction. At a third, even more general level, companies should consider methods to change their internal planning and decision-making processes. Just as the Board should require environmental considerations to be brought to their attention in all decision-making, management processes should also be revised to ensure that environmental concerns are visibly integrated into every day management.

Traditional waste audits, which have always been one aspect of a good operational audit, have often focused primarily on compliance, e.g. ensuring that wastes are lawfully handled by proper haulers with appropriate manifests. More ambitious operational (and waste) audits have also looked at opportunities for waste reduction and diversion, for the sake of saving costs and improving efficiency. These broader waste audits will now be required under Bill 143 and its regulations.

Product audits (or life-cycle audits) are an expression of product stewardship. They are intended to allow a company to determine the total impact of what they produce, from cradle to grave. There is still substantial controversy over the methodology to be used, but the general concept of product stewardship is gaining increasing acceptance. Packaging audits are the province's first step in this direction.

Audits of Existing Property

The function of a property audit is to determine whether any properties owned or occupied by the company are contaminated, and if so, to what extent They typically include at least the following steps:

a) Determine the history of the property

b) Sample and analyze, if necessary.

c) Identify type, area and degree of contamination.

d) Determine whether the contamination exceeds applicable standards for residential / industrial use.

d) Determine whether site cleanup is legally required / desirable.

Such audits are often done in two stages: a preliminary screening which looks for signs of trouble, and the more detailed examination which follows if the first screening suggests grounds for concern.

Acquisition audits

One important opportunity to profit from environmental awareness is to avoid the unintended acquisition of contaminated property. A prudent company performs property audits, operations audits, or both prior to acquiring any interest, whether ownership, possessory, security, or other, in new businesses or properties. Without such audits, it is impossible to obtain an accurate assessment of the true value of the acquisition.

Other types of possible audits include energy audits, and total materials budgets.

STEP 3: Identify Solutions, Prepare action plan

This is the most creative and important part of a green plan. It is also the part most heavily affected by the directors' environmental goals: does the company wish to be an environmental leader or only to stay in compliance with the law? At a minimum, the company should try to identify solutions to all problems of actual non-compliance. The company should also consider ways of reducing identified risks of accidents. It may also wish to consider how to exploit opportunities to become more efficient and/or to profit from going "green".

One of the most important sources of ideas for possible solutions is to be aware of what others are doing. Each company should aim to exceed the average for its industry. A company which falls behind the average in its field will probably be unable to show due diligence.

The solutions identified must then be evaluated, and organized into an action plan. The plan should organize, priorize, and allocate time and money to accomplish the chosen solutions. It should be specific, concrete and timely. It should be designed both to remedy existing deficiencies, and to ensure future compliance. Leadership companies may also plan to improve cooperation and environmental performance throughout their industry, and to work with government in the development and refinement of regulatory initiatives.

Bill 143 and its associated regulations institutionalizes this step by requiring companies to prepare waste reduction workplans, and to include waste separation as part of the plan.

In addition to all the specific details identified through the previous steps, the plan should:

i) establish a general pattern of attentiveness in relation to environmental matters, including good communications both internally and externally;

iii) systematically address each of the major environmental hazards of the corporation's activities, including a contingency plan for emergencies;

ii) clearly define environmental responsibilities, and make them part of the main job of every line manager in the company, with appropriate incentives for top performance;

iii) designate a senior manager of environmental affairs, to be responsible for keeping the company up to date with regulatory change and to provide technical support to the line managers;

iv) establish a system for responding professionally to government inspections and investigations, and for reporting spills; and

v) make realistic allowances for the delays and expense of obtaining any necessary government approvals.

A key element in the plan should therefore be significant improvements in management information systems, to ensure that both directors and management receive current information about the environmental status of the company, and timely feedback about the success of their efforts to control environmental impacts. In larger companies, computerization may be essential. In the longer run, these information systems will be most effective if integrated with the accounting systems used to manage its economic and financial performance.

STEP 4: Communication

An essential part of all parts of a green plan is communication with interested stakeholders.

Employees, for example, must understand the environmental risks of the business and the importance of avoiding environmental damage. Employees must understand what the company is trying to do, why, and how to make it happen. They should also have an opportunity to make suggestions to improve the plan. Health and safety committees are often interested in contributing in this way.

It may also be valuable to communicate the highlights of the plan to your customers. Significant environmental improvements by your company can be an important selling point.

Shareholders must also be educated about the plan. They need to understand that the green plan represents an investment in the future, and how it will help to protect the value that brought them to the corporation in the first place. It may also be useful to bring the plan to the attention of potential investors who seek "green" investments.

Securities regulators are now developing increasingly stringent requirements for the disclosure of "material" information about environmental matters. Institutional investors and pension funds also request such information with increasing frequency.

Another important component of implementing a green plan is establishing good relations with the public and regulators. This could include establishment of a liaison committee in order to:.

i) Communicate what you are doing right

ii) Be prepared to learn where you can improve

iii) Show your willingness to solve environmental problems so that your neighbours will come to you with their concerns before they call in the environmental police.

Bill 143 and its regulations begin to institutionalize this requirement by demanding that companies post their waste reduction workplans.

STEP 5: Implement action plan

In order to achieve the corporation's goals, it is critical to ensure that the action plan is methodically implemented and that the most serious risks are dealt with first. This can be a complex and demanding task, requiring several years. In particular, the difficulty of obtaining government approvals should not be under-estimated. If implementation is to be phased, it will be necessary to consider how to limit company liability in the interim.

The success of the action plan will depend upon the commitment of the CEO. Staff are unlikely to take it seriously unless the CEO does.

In the past, some companies have performed audits, developed action plans and then failed to implement them. There is nothing more dangerous to a due diligence defence, especially when the workplans have been filed with the government or are otherwise accessible to the eager IEB.

STEP 6: Follow up

A green plan is a long term investment that requires continuing attention. It is essential to monitor the results of the action plan, and to amend it as required. The environmental audits and action plan should be updated regularly to take account of changes in the company's operations as well as the development of new scientific knowledge, the availability of new technology, and regulatory changes. Should an environmental incident occur or should warnings be delivered by government officials, management should be required to promptly re-evaluate existing control systems.

The directors should require management to make regular progress reports as the action plan is implemented, and should evaluate its adequacy at least annually. The entire cycle should be repeated periodically, perhaps every five to ten years.

Bill 143 and its regulations are expected to require reviews of the waste reduction workplans at least annually. Periodic repetitions of the waste audits are also possible.

Conclusion

Bill 143 and the regulations which will implement it employ a methodology intended to force corporations to take more responsibility for sustainable development, and for reducing Canada's consumption and waste. We can expect that the same methodology will be used increasingly in the next few years in more and more areas of environmental management, such as elimination of toxics, and improvement of air and water quality as well as waste. Prudent companies will therefore acquire a mastery of these techniques, and will prepare for their expansion to other areas of environmental regulation. In fact, these techniques are merely an illustration of the broader method of integrating environmental concerns into corporate management which will be more and more important for long term competitiveness.

Appendix: Sample RESOLUTION OF THE BOARD OF DIRECTORS

1. General

1.1 ABC CO. will to do everything reasonably within its power to protect and conserve the natural environment for present and future generations. This is among ABC Co.'s highest priorities.

1.2 ABC CO. will do everything reasonably within its power to comply with applicable environmental laws, including federal, provincial and municipal laws.

2. Sustainable Development

2.1 Environmental considerations shall be thoroughly integrated into the management of ABC CO..

2.2 Management shall thoroughly review environmental impacts before making or recommending all significant decisions.

2.3 ABC CO. will do everything reasonably within its power to avoid spills and other accidental discharges of contaminants into the natural environment, especially from the manufacturing, storage, transportation or other handling of raw materials, products or wastes.

2.4 ABC CO. will be prepared to contain and clean up spill and to respond appropriately to any other emergency.

2.5 ABC CO. will annually evaluate and improve its products and processes so as to progressively reduce any adverse effects on the environment.

2.6 ABC CO. will progressively reduce routine discharges of contaminants into the environment.

2.7 Whenever practical, ABC CO. will convert its manufacturing processes from open to closed-loop systems.

2.8 ABC CO. will strive to virtually eliminate discharges of persistent toxic chemicals by the year 2000.

3. Product Stewardship

3.1 ABC CO. recognizes that it shares in the responsibility for the environmental impact of the products it produces, from their initial creation to their ultimate disposal.

3.2 ABC CO. will design and manufacture all of its products so as to minimize any adverse effects on the environment., and maximize efficiency in the use of energy and natural resources.

3.3 ABC CO. will co-operate with other public and private bodies to develop systems for the re-use and recycling of ABC Co.'s products, and for progressively increasing the recycled content of ABC Co.'s products.

4. Waste Management

4.1 ABC CO. will take active steps to reduce the waste which it sends for disposal.

4.2 ABC CO. will give priority to waste reduction, re-use and recycling, in that order.

4.3 ABC CO. will strive to reduce the quantity of waste which it sends for disposal by 20% by the end of 1992, by 35% by the end of 1996, and by 50% by the end of 2000, all calculated in reference to the waste sent for disposal in 1987. ABC CO. will ensure that all of its wastes are disposed of safely and lawfully.

5. Communication

5.1 ABC CO. will educate its employees to work in an environmentally responsible manner.

5.2 ABC CO. will encourage its suppliers to adopt environmental practices consistent with this policy.

5.3 ABC CO. will assist its customers to safely use and dispose of its products, including reuse and recycling when practical.

5.4 ABC CO. will foster openness and dialogue with employees and the public, in order to understand and respond to their concerns about any impacts of ABC Co.'s activities.

6. Implementation

6.1 Senior management shall perform a thorough audit of ABC Co.'s operations and shall prepare an action plan to implement the policies set out in this resolution.

7. Monitoring

7.1 An environmental progress report shall be submitted to the directors at each meeting of the board. A detailed evaluation shall be submitted at least annually.

8. Business Charter

8.1 ABC CO. shall advise the International Chamber of Commerce of its support for the ICC Business Charter for Sustainable Development.

EPA'S 33/50 PROGRAM SECOND PROGRESS REPORT REDUCING RISKS THROUGH VOLUNTARY ACTION

by
Susan Hazen, Office of Pollution Prevention and Toxics, U.S. Environmental Protection Agency, Washington, D.C.

SUMMARY

EPA's 33/50 Program is a year old, and one year closer to its goals of reducing toxic chemical pollution through voluntary, direct action by industry. Company participation in the 33/50 Program has increased more than three-fold since the issuance of the Program's first Progress Report in July of 1991. As of February 1992, 734 companies had written to EPA expressing commitments to reduce voluntarily their releases and transfers of toxic chemicals, up from 236 company commitments in July. The actual reductions pledged by these companies also has risen significantly during the past six months, from 201 million pounds in July to 304 million pounds in February.

The 33/50 Program seeks to reduce the generation of high-priority industrial toxic wastes by 50% by 1995, with an interim goal of a 33% reduction by 1992. Marking its first anniversary, this report examines progress in achieving the Program's ambitious goals and reviews the activities conducted over the past year to bring about this progress. In addition, the report provides an overview of the universe of toxic chemical releases and transfers addressed by the 33/50 Program. And finally, anniversaries also offer a time for looking forward, to assess the challenges — and potential pitfalls — ahead in forging a voluntary pollution prevention partnership among governments at all levels, communities, and industries.

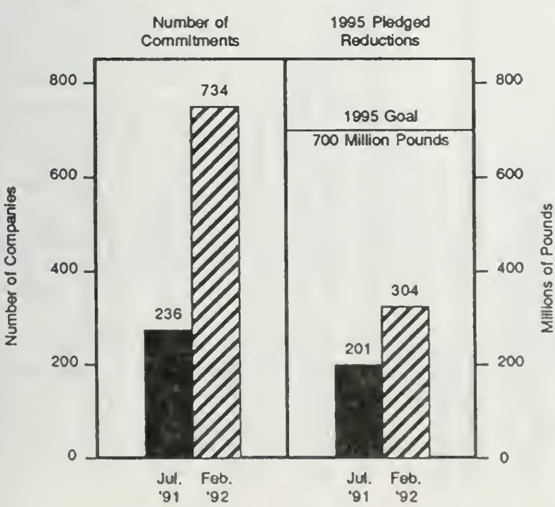


Figure 1. Progress of the 33/50 Program.

17 CHEMICALS OF THE 33/50 PROGRAM

BENZENE
CADMIUM & COMPOUNDS
CARBON TETRACHLORIDE
CHLOROFORM
CHROMIUM & COMPOUNDS
CYANIDES
LEAD & COMPOUNDS
MERCURY & COMPOUNDS
METHYL ETHYL KETONE
METHYL ISOBUTYL KETONE
METHYLENE CHLORIDE
NICKEL & COMPOUNDS
TETRACHLOROETHYLENE
TOLUENE
TRICHLOROETHANE
TRICHLOROETHYLENE
XYLENES

33/50 PROGRAM OVERVIEW AS OF MAY 15, 1992

	"TOP 600" CONTACTED IN MARCH, 1991	"5400" COMPANIES CONTACTED IN JULY, 1991	TOTAL FROM ALL COMPANIES AS OF 5/15/92
COMPANIES			
SOURCES OF RELEASES OR TRANSFERS OF THE 17 CHEMICALS COVERED BY THE 33/50 PROGRAM			
COMPANIES CONTACTED BY EPA	555	5,192	5,747
RESPONSES WITH COMMITMENTS TO 33/50 PROGRAM	286	511	797 ←
RESPONSES WITH QUANTIFIABLE COMMITMENTS	241	348	589
QUANTITIES OF THE 17 TARGETED CHEMICALS COVERED BY THE 33/50 PROGRAM (MILLIONS OF POUNDS)			
TOTAL RELEASES AND TRANSFERS REPORTED TO TRI IN 1988 (FROM 12,000 FACILITIES)	1,046	385	1,431
TOTAL FROM THE COMPANIES MAKING COMMITMENTS	775	47	823
TOTAL FROM THE COMPANIES WITH QUANTIFIABLE COMMITMENTS	660	30	690
AMOUNT OF REDUCTIONS FROM QUANTIFIABLE COMMITMENTS	322	19	341 ←

THE 33/50 PROGRAM: A ONE-YEAR PROGRESS REPORT

REDUCING TOXIC RISKS THROUGH VOLUNTARY DIRECT ACTION

THE 33/50 PROGRAM

EPA's 33/50 Program is a year old — one year closer to its goals for reducing toxic chemical pollution through voluntary, direct action by industry. The 33/50 Program seeks to reduce the generation of 17 high-priority industrial toxic wastes by 50% by 1995, with an interim goal of a 33% reduction by 1992. The Program was formally announced in February 1991, and the first 33/50 Progress Report was released in July 1991. This report examines the progress of the 33/50 Program at its first anniversary, and looks ahead to the progress — and potential pitfalls — of the next few years.

GOALS AND APPROACH

The 33/50 Program is an ambitious EPA initiative designed to reduce toxic waste generation from industrial sources quickly and with an unprecedented degree of flexibility. Industry participation in the 33/50 Program is ***voluntary***: the Program aims to demonstrate that voluntary reduction programs can augment the Agency's traditional regulatory approach by achieving targeted reductions more quickly than would regulations alone.

The 33/50 Program derives its name from the overall goals — an interim goal of a 33% reduction by 1992 with an ultimate goal of a 50% reduction by 1995 in environmental releases and off-site transfers of 17 high-priority toxic chemicals, using 1988 as a baseline year. In 1988, almost 6,000 companies reported to the Toxic Release Inventory (TRI) that 1.4 billion pounds of the 33/50 chemicals were either released to the environment or transferred off-site to waste management facilities. The aim of the 33/50 Program is to reduce this 1.4 billion pounds of wastes by *at least* 50%, or 700 million pounds, by 1995.

> **Industry Embracing Voluntary Reduction Goals**
>
> The 33/50 Program's challenge to American industry to voluntarily reduce toxic chemical releases is being embraced by a wide spectrum of companies, ranging from Fortune 500 firms such as **AT&T** and **Du Pont** to small and midsized companies like **Magee Carpet** of Bloomsburg, Pennsylvania and **Ultra Forge** of Cuyahoga Falls, Ohio. For a description of the reduction programs being implemented by these and other companies, see "**33/50 Activities - What Industry Is Doing**." A complete list of all companies participating in the 33/50 Program is included in **Appendix A**.

The 33/50 Program is part of a broad EPA thrust to encourage ***pollution prevention*** as the best means of reducing risk to human health and the environment. Pollution prevention moves the focus on toxic chemicals *upstream*, away from managing wastes after they have been generated, towards an approach that avoids the generation of wastes wherever possible through toxics use reduction, equipment and process changes, improved handling and operations, and so on. Although the goal of EPA's 33/50 Program is expressed as a 50% reduction in TRI environmental releases and transfers by 1995, a goal chosen to allow for progress to be measured with readily available data, the central theme of the program is to promote continuous environmental improvement through pollution prevention. Therefore, EPA urges companies to use pollution prevention as the preferred means of achieving their reductions. Moreover, EPA hopes that by emphasizing pollution prevention, companies will instill a new management ethic that will achieve even greater environmental benefits, expanding their reduction efforts beyond the chemicals, targets, and time frames established for the 33/50 Program.

The goal of the 33/50 Program includes the reduction of both direct releases to the environment (1,134 million pounds) and off-site transfers of waste materials to sewage treatment plants or commercial waste management facilities (297 million pounds). While it is important to understand the difference between direct releases to the environment and off-site transfers of wastes, both are included in our measures of progress because the central theme of the 33/50 Program is to promote pollution prevention. Thus, EPA has included all waste materials, regardless of whether they are released or transferred, to encourage industry to consider all waste generation when reviewing their pollution prevention options.

33/50 AND THE TOXICS RELEASE INVENTORY

The chemicals included in the 33/50 Program are 17 high-priority toxic chemicals that are among the more than 320 chemicals reported annually to the Toxics Release Inventory (TRI). These chemicals were selected for attention by the 33/50 Program not only because of toxicity concerns, but because they are all commonly used in high volumes by industry, and they all have high potential for reduction through pollution prevention.

In 1988, the baseline year for the 33/50 Program, these 17 chemicals accounted for 22% of the total quantities reported to TRI (1.4 out of 6.4 billion pounds). Another reason for targeting these particular chemicals in the 33/50 Program is that they are handled by a significant portion of the facilities required to report under TRI. More than 12,000 facilities associated with almost 6,000 companies reported releasing and/or transferring one or more of the 33/50 chemicals in 1988. This represents 57% of the more than 21,000 TRI facilities that reported in 1988. (See Figure 2.)

EPA'S 33/50 PROGRAM: THE 17 CHEMICALS TARGETED FOR REDUCTIONS

BENZENE
CADMIUM & COMPOUNDS
CARBON TETRACHLORIDE
CHLOROFORM
CHROMIUM & COMPOUNDS
CYANIDES
LEAD & COMPOUNDS
MERCURY & COMPOUNDS
METHYL ETHYL KETONE
METHYL ISOBUTYL KETONE
METHYLENE CHLORIDE
NICKEL & COMPOUNDS
TETRACHLOROETHYLENE
TOLUENE
TRICHLOROETHANE
TRICHLOROETHYLENE
XYLENES

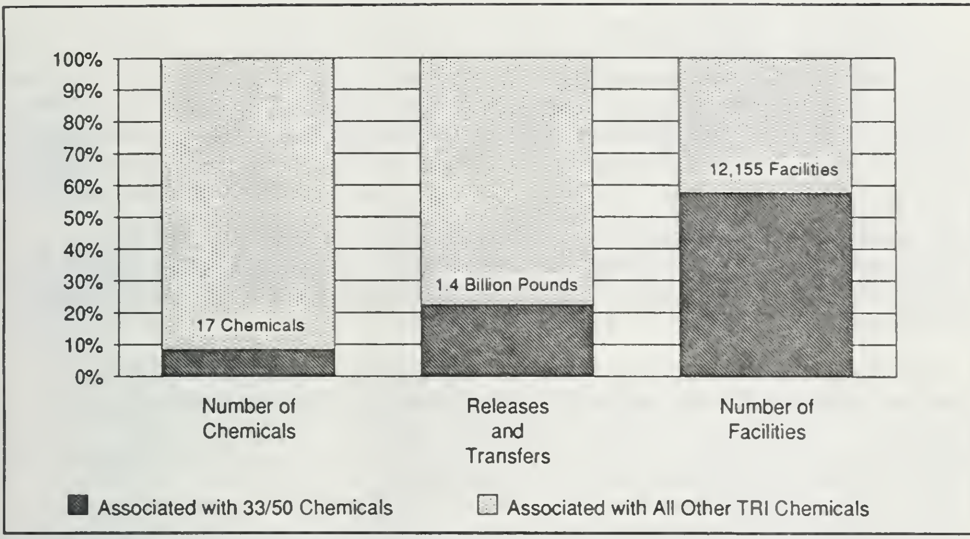


Figure 2. Total TRI and 33/50 Program Universe, 1988.

Pollution prevention benefits resulting from the Program could potentially extend to a substantial portion of the entire TRI universe, since companies are encouraged to consider reduction commitments beyond the goals of the 33/50 Program.

IMPLEMENTING THE 33/50 PROGRAM: EPA'S APPROACH

To achieve 33/50's goals, EPA developed a program consisting of four major elements: **outreach** to companies to encourage commitments; **public recognition** of companies for their commitments, pollution prevention efforts, and achievements; **technical assistance** to help companies overcome barriers and achieve commitments through pollution prevention practices; and **evaluation** of the effectiveness of both industry and government efforts in a voluntary, cooperative program.

Outreach: Perhaps the major challenge for the 33/50 Program is reaching out to the thousands of companies and over ten thousand facilities that can play a role in reducing toxic wastes. Letters to the heads of companies can be effective, but they are also easily overlooked by busy corporate executives with many priorities. There is also history and culture to contend with. The 33/50 Program is building a new type of relationship between government, communities and industry. Many companies, used to dealing with EPA or the public only in an adversarial relationship, are hesitant to embrace an EPA-sponsored voluntary program, no matter how sensible it might seem on paper. In order to make the most of our communications, EPA employed the following strategy:

A **first round** of intensive contacts with the "Top 600"[1] companies. This entailed not only letters from the Administrator to company heads, but a series of about a dozen meetings with top executives from different industrial manufacturing sectors: chemicals; transportation related; machinery and electrical equipment; iron, steel, and primary metals; pulp and paper; petroleum refining; pharmaceuticals; wood and metal furniture; rubber and related products; and metal finishings and coatings. Trade associations, such as the Chemical Manufacturers Association, were instrumental in helping arrange these sessions. Program communications with individual company managers have also occurred through meetings with EPA Regional Administrators and staff and regional workshops with State program participation. Face to face contacts were invaluable in identifying issues, addressing questions, and providing assurances as to how the Program would and would not operate.

A **second round** of contacts involved not only letters to the heads of thousands of additional companies, but many direct meetings between EPA's Regional Offices and industries within their States. As many as a thousand additional companies will be contacted as new companies report to TRI for the first time, or as corporate affiliations change through sales, purchases, restructuring, and the like.

Continuing our outreach efforts, 33/50 Program staff have addressed conferences, provided information to the press, written articles, and circulated information about the Program wherever opportunities presented themselves. In this way, we can reach not only industry, but environmental groups, community organizations, organized labor, and the general public. The 33/50 Program is also independently reported on in the annual National Report released by the TRI Program. In addition, EPA routinely contacts companies that have not yet joined 33/50 to make certain they are aware of the Program, and to solicit their participation.

Public Recognition: EPA's release in 1989 of the first year of TRI data greatly increased public awareness about toxic pollution and industrial awareness of the depth of community concern about toxic wastes. The 33/50 Program provides industry a means of having its progress towards pollution prevention recognized through a formal EPA program that receives broad public attention. At the same time, the commitment information submitted to 33/50 provides the public with access to information beyond that supplied in TRI reports.

In order to foster public awareness of industry's reduction efforts, the 33/50 Program publicizes company participation through Program publications, press releases, and in speeches and other routine federal and State communications: Companies submitting reduction commitments receive a formal certificate of participation from EPA. This year's **Administrator's Awards Program,**

More About 33/50...

Want to find out more about EPA's 33/50 Program? See the back page of this report for **what's** available, **who** to contact, and **where** to call, visit, or write.

1 Nearly 600 companies accounted for more than 75% of the total 1988 releases/transfers of 33/50 chemicals.

highlighting outstanding achievements in pollution prevention, is being coordinated with the 33/50 Program. Next year, 33/50 envisions having its own awards program to recognize company efforts in reducing wastes, *including those that go beyond the goals set by 33/50*, creating effective pollution prevention programs, communicating with and involving the public, and in other areas warranting special recognition. In addition, we are developing a compilation of **33/50 Company Progress Reports** which will highlight effective company approaches to identifying pollution prevention opportunities and follow them through implementation.

Technical Assistance and Technology Transfer: The 33/50 Program is working closely with EPA's Office of Research and Development to help companies implement pollution prevention through information collection, coordination, and exchange. To date, there are five components to the 33/50 Program's technology assistance and transfer efforts:

1) The 33/50 Program is conducting a series of workshops across the country with industry to exchange information on pollution prevention theory and practices to aid in achieving reductions of the 17 chemicals.

2) EPA is expanding its Pollution Prevention Information Exchange System, a free computer bulletin board associated with EPA's Pollution Prevention Information Clearinghouse. The Bulletin Board and Clearinghouse contain technical, policy, programmatic, legislative, and financial information on pollution prevention, in general, and the 33/50 Program, in particular.

3) EPA is preparing a series of bibliographic reports on pollution prevention and recycling techniques applicable to the major industries which release the 17 targeted chemicals.

4) EPA is publishing an expanded pollution prevention resource guide, **Pollution Prevention Resources and Training Opportunities in 1992**, which identifies key pollution prevention documents, industry specific guidance manuals, fact sheets, and videos. The guide also identifies federal, state, university, and other pollution prevention programs across the country. For example, the guide contains a complete listing of State programs that offer technical assistance on pollution prevention and waste minimization to businesses and industry.

5) EPA is identifying areas where new research efforts could lead to beneficial and readily transferable pollution prevention alternatives. As part of this effort, EPA will identify successful and innovative pollution prevention practices companies have implemented as part of the 33/50 Program and then share this information with other companies and other interested parties.

Program Evaluation: How well is the 33/50 Program working? Are reductions being achieved through pollution prevention? Do EPA regulatory programs or other barriers inhibit companies from making voluntary reduction commitments? Would reductions occur anyway without 33/50? These are important questions that need to be answered in order to determine ***if*** the 33/50 approach works, ***why*** it is working, and ***what*** it is accomplishing. We are examining potential **regulatory obstacles** to pollution prevention in order to identify areas where EPA can remove obstacles without undercutting statutory mandates or environmental progress. Detailed **company progress reports**, prepared as part of program outreach, are focussing on incentives and obstacles to pollution prevention; they will allow independent validation of pollution prevention successes. A particular concern is documenting the extent to which reductions come about through true pollution prevention measures. As a result of passage of the Pollution Prevention Act of 1990, new TRI information on pollution prevention practices and the impact they are having will become available to EPA and to the public. Some companies are also providing additional information in their progress reports to the 33/50 Program. This information will provide invaluable insights towards evaluating the effectiveness of the Program.

33/50 AND OTHER FEDERAL, STATE, AND INTERNATIONAL PROGRAMS

The 33/50 Program is only one of the many pollution prevention activities underway at EPA, in the States, and elsewhere. Our activities are coordinated closely with other programs, wherever possible, so that there is a maximum impact with a minimum of overlap. Some of the cooperative efforts are described in the following paragraphs.

Other EPA Pollution Prevention Programs: Recent reorganizations at EPA have brought the 33/50 Program and the Pollution Prevention Division institutionally closer as a means of coordinating activities. EPA's new Office of Pollution Prevention and Toxics provides a central location for the Agency's pollution prevention activities. The 33/50 Program is becoming a key source of information for the **Pollution Prevention Information Clearinghouse**. We work closely with the **early reductions program** established by the Clean Air Act Amendments of 1990 to coordinate efforts to reduce industrial discharges of toxic chemicals prior to legislatively mandated schedules. The 33/50 Program is being looked to as a possible model as the Agency conducts a broad review of major regulatory activities, with the aim of further promoting pollution prevention. For example, the voluntary, direct action approach is proving successful not only in 33/50, but in EPA's energy conservation/pollution prevention initiative, **The Green Lights Program**.

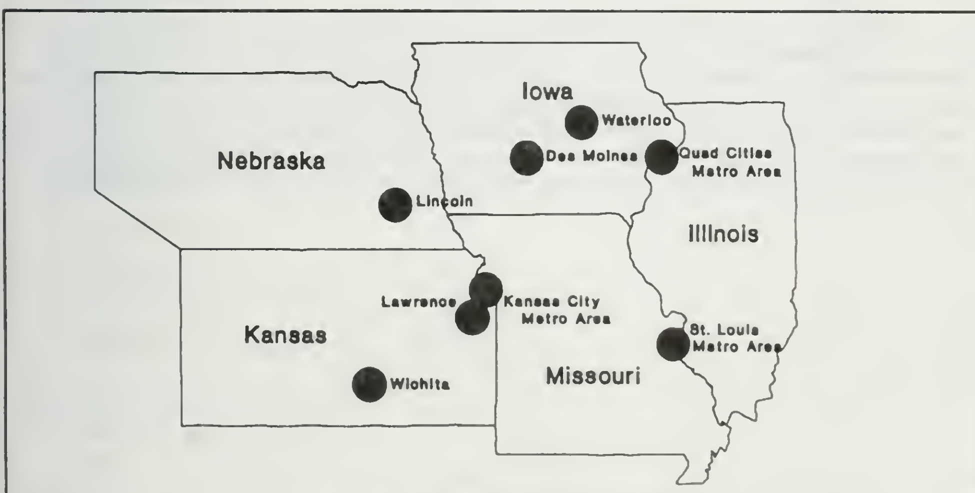
Other Federal Programs: 33/50 also is being considered as a potential model for a broad **Federal Sector** initiative, focussing on federal government facilities as generators of toxic releases. It would build on existing pollution prevention activities by setting ambitious reduction targets and creating a formal tracking system to measure progress. A large number of the Government Owned **Contractor** Operated facilities of the Department of Defense and the Department of Energy are operated by companies already committed to 33/50. We will continue our discussions with these Departments in order to make maximum use of the 33/50 approach for these facilities as well as Government Owned **and** Operated facilities.

EPA Regional Programs: EPA's Regional Offices play an important role in communicating Program goals to industry, States, and the community. Major activities include seeking company participation through individual company contacts and participation in regional and state meetings, and coordinating the implementation of the

Program with State pollution prevention and toxic use reduction initiatives. Through these activities, EPA seeks to minimize the potential for conflict with State programs and to develop cooperative efforts with industry, States, and the community.

EPA Region VII, with the participation of Region V, has taken a very innovative approach to the 33/50 Program. Working with the TRI list of the top 100 counties nationally for releases and transfers of the targeted 33/50 chemicals, Region VII selected the five counties and three metropolitan areas in its region that ranked highest (see Map A). By the end of 1991, the Regions, in cooperation with State agency and department officials, met with business and civic leaders and company representatives in each of these counties and metropolitan areas to encourage voluntary, **community-wide** reduction goals for all reported TRI chemical releases and transfers. They asked these communities for a separate focus on the 17 targeted 33/50 chemicals. A key distinction from the national 33/50 Program is that the geographic-oriented program targets groups of **facilities** in selected areas, as opposed to parent companies.

Through this effort in Region VII, a group of representatives from 26 companies and McConnell Air Force Base has announced its plan to reduce Sedgwick County TRI wastes by more than 90% by 1995. This is a reduction of 142 million pounds compared to the 1988 total of 151 million pounds in the county. The group also plans to reduce all TRI wastes by 31% (47 million pounds) by 1992. Other community-wide meetings have resulted in the formation of groups or steering committees to obtain similar commitments to achieve the 33/50 Program goals.



Map A. Geographic Voluntary Emissions Reduction Program, Communities in EPA Regions VII and V.

States: Pollution prevention has been a priority in many States for some time. The 33/50 Program has been a direct benefactor and is building onto the foundation established by these State initiatives. Many States have taken a strong interest in the 33/50 Program and are using it to their advantage to foster pollution prevention. States like California, Florida, Maryland, and North Carolina have written to companies encouraging participation in the Program. Other States such as Louisiana and New York are tracking reductions in the 33/50 Program chemicals as part of their State Toxics Programs. New York has already reported a sizable reduction, from 69 million pounds in 1988 to 36 million pounds in 1990, which will no doubt increase as the 33/50 Program builds momentum.

Yet other States like Colorado, Delaware, and Minnesota have their own voluntary reduction initiatives either in process or in place. For instance, Minnesota has launched the Minnesota 50 Project which sets a statewide 50% reduction goal for 1995 for the same chemicals included in 33/50. Minnesota 50 will reach many individual facilities in the State that would not otherwise be contacted by EPA, thus expanding the scope and potential impact of the voluntary reductions approach.

Several States (such as Connecticut, Massachusetts, Pennsylvania, and Rhode Island) are holding pollution prevention and technical assistance conferences that include discussions of 33/50 and disseminate information about the technologies that can be applied to reduce or eliminate the use of 33/50 and other hazardous chemicals. Activities such as the Northeast Waste Management Officials Association's distribution of a brochure describing the 33/50 Program and the technical assistance available in New England States also aid the 33/50 Program. Overall, Federal/State partnerships are forming to foster source reduction not only for the 33/50 chemicals, but for other hazardous chemicals as well, promoting a pollution prevention ethic within the respective States.

International: The 33/50 Program is seen as a possible model for voluntary reduction efforts in the international arena. EPA has been working with Environment Canada, the International Joint Commission, and others on a **Pollution Prevention Initiative for the Great Lakes** that incorporates 33/50 goals for reducing toxic discharges to these international waterways. Pollution prevention initiatives have been included in the Mexico-United States Plan to protect the border environment. For example, American corporations will be encouraged to make commitments to the Program for their facilities across the border.

INDUSTRY'S PARTICIPATION IN THE 33/50 PROGRAM

Nearly 6,000 companies — operating more than 12,000 facilities nationwide — submitted TRI reports to EPA for the year 1988 on one or more of the 33/50 chemicals. This is more than half of all facilities that reported to TRI. All told, these companies reported 1.4 billion pounds of releases and transfers of the seventeen chemicals in 1988, the baseline year for the 33/50 Program. All 5,747 companies have been invited to participate in the 33/50 Program (see Table 1).

The bulk of releases and transfersof these chemicals reported to TRI came from relatively few companies. Five hundred and fifty-five of the 5,747 companies accounted for more than three quarters (1.1 billion pounds) of the total for the 33/50 chemicals. This group of companies (often referred to as the "Top 600" companies) were sent letters by EPA in February 1991 inviting them to join the 33/50 Program. As reported in the first Progress Report, more than one-third (236 companies) had responded with a commitment to the program by July 1991. Since then 39 more of these companies have joined the

TABLE 1. 33/50 PROGRAM COMMITMENT STATUS OVERVIEW

	"TOP 600" AS REPORTED IN JULY PROGRESS REPORT	"TOP 600" AS REPORTED IN THIS PROGRESS REPORT	REMAINING COMPANIES CONTACTED IN JULY, 1991	TOTAL
NUMBERS OF COMPANIES				
Companies Contacted by EPA	555	555	5,192	5,747
Companies Committing To 33/50 Program	236	275	459	734
Companies Providing Quantifiable Commitments	140	228	334	562
TRI RELEASE/TRANSFER QUANTITIES FOR THE 17 33/50 CHEMICALS (in millions of pounds, 1988)				
Total for 33/50 Chemicals	1,050	1,050	381	1,431
Total from Companies Committing to 33/50 Program	—	640	104	744
Total from Companies Providing Quantifiable Commitments	389	514	85	599
REDUCTION COMMITMENT QUANTITIES, 1988 TO 1995 (in millions of pounds)				
Amount of Reductions in TRI Release and Transfers Pledged by Companies Providing Quantifiable Commitments	201	260	44	304

Program. To date, almost half of the "Top 600" — 275 companies — have voluntarily submitted reduction commitments to the 33/50 Program. These 275 companies represent 45% (640 million out of 1.4 billion pounds) of the wastes targeted by the 33/50 Program for reductions.

In July 1991, EPA sent letters to the remaining 5,192 companies that reported use of 33/50 chemicals to TRI in 1988, asking them to respond by November 1991. Of this second group of companies, 459 have thus far committed to participating in 33/50, accounting for an additional 104 million of the 1.4 billion pounds of 1988 33/50 releases and transfers. We recognize that this second round of companies have had less time to consider their participation in 33/50, and some may not have the level of resources available to many of the larger companies. Nonetheless, their participation is crucial to the success of the 33/50 Program, not only in terms of meeting our numerical goals but, in a broader sense, for fully promoting the pollution prevention culture throughout the industrial sector.

Across the two groups of companies, a total of 734 companies have indicated their willingness to reduce voluntarily their releases and transfers of the 33/50 chemicals a more than three fold increase since July (see Figure 3). All are listed in **Appendix A**. Together these 734 committed companies released and/or transferred 744 million pounds of the total 1.4 billion pounds associated with the 17 chemicals.

Of the 734 companies that have committed to the Program, 562 (77%) have responded with readily quantifiable reduction goals: 228 of these were from the "Top 600" and 334 from the second group. These goals lend themselves to numerical calculations of how much of its releases and transfers a company plans to reduce by 1995. By looking at these 562 companies with quantifiable commitments, we are able to determine the level of commitment that has been made as of this progress report. Of the 599 million pounds of releases and transfers of 33/50 chemicals associated with these companies, firms have committed to a reduction of 304 million pounds by 1995 (260 million pounds from the "Top 600"; 44 million from the rest). This pledged reduction of 304 million pounds represents an increase of 51% from the 201 million pounds commited to as of July, 1991, and 43% of the national goal of 700 million pounds (see Figure 4). Although individual company commitments vary considerably in amount, reduction pledges are averaging 50% per firm (304 million pounds of pledged reductions out of the 599 million pounds of 33/50 chemical releases and transfers reported by this group in 1988).

The 304 million pound national reduction commitment actually represents a lower bound in assessing the 33/50 Program's progress to date. This estimate is based only on a portion of the 734 company commitments received to date — the 562 commitments that can be quantified on a company-wide basis. Additional reductions have been pledged by companies on a chemical-, medium-, or facility-specific basis, requiring further analysis by EPA before their contributions toward the national goals can be accurately assessed. Other companies that have committed to the 33/50 Program have yet to specify their numerical goals. In some instances, these companies have indicated that they need to analyze their industrial processes before determining the level of reduction they can achieve.

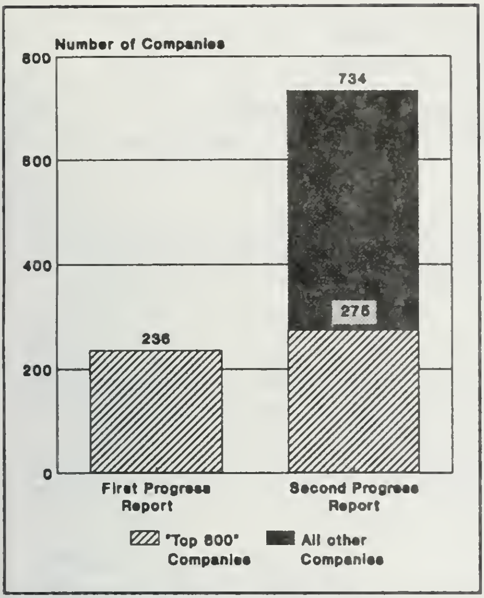


Figure 3. Companies Committing to the 33/50 Program.

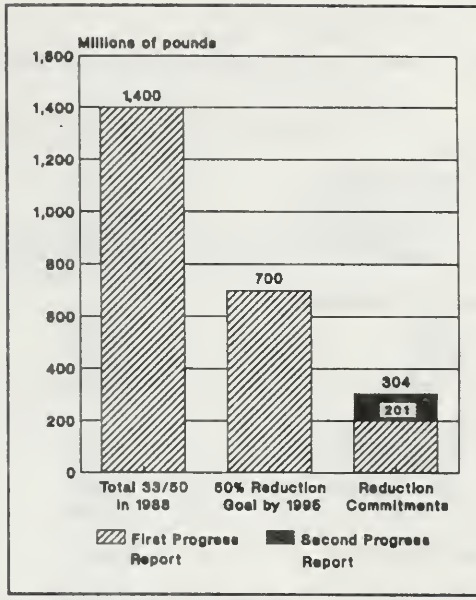


Figure 4. Releases and Transfers of 33/50 Chemicals.

On the other hand, a number of companies have submitted quite detailed reduction commitments. One example is the commitment provided by LTV Steel Company, planning an overall 80% reduction by 1995 that is broken down by individual chemical (see Table 2). In another example, Honda of America supplied EPA with specific details of the planning needed to achieve their reduction goals (see Table 3).

The 33/50 Program's national goal of 700 million pounds reduction by 1995 is based upon achieving a 50% reduction in the 1.4 billion pounds of the 33/50 chemicals that were released and/or transferred in 1988. One way to achieve this goal is for every one of the 5,747 companies to commit to the Program with a 50% reduction in their releases and transfers. Realistically, however, some companies will choose not to participate in the Program and of those that do, some will make commitments amounting to less than a 50% reduction. Therefore, if the overall goal of a 700 million pound reduction is to be achieved, many companies will need to make commitments to reducing their releases and transfers of the 17 chemicals by greater than 50% and, indeed, some already have.

While there is much to be excited about with the level of voluntary commitment we are seeing by companies responding to the 33/50 Program, we clearly have a long way to go if we are to meet our national goal. EPA has planned follow-up activities involving those companies who did not respond or who responded expressing an interest in, but not a commitment to, the 33/50 Program.

TABLE 2. SAMPLE COMPANY REDUCTION GOALS (LTV STEEL)

	1988	% REDUCTION	1995
SOLVENTS			
Methylene Chloride	100,895	100	0
Methyl Isobutyl Keytone	170	0	170
Tetrachloroethylene	313,200	100	0
1,1,1-Trichloroethane	600,000	100	0
Subtotal	1,014,265	100	170
COKE PLANT CHEMICALS			
Benzene	1,282,698	89	142,400
Toluene	28,200	67	9,420
Xylene	150,000	50	75,710
Subtotal	1,460,898	84	227,530
METAL COMPOUNDS			
Chromium Compounds	318,712	0	318,712
Cyanide Compounds	9,256	0	9,256
Nickel Compounds	11,743	0	11,743
Subtotal	339,711	0	339,711
GRAND TOTAL	2,814,874	80	567,411

INDUSTRY FEEDBACK ON THE 33/50 PROGRAM

Why are companies voluntarily agreeing to cut back their toxic discharges? Many of the companies committing to 33/50 reductions have indicated their reasons for doing so. Among the most common are:

- Companies are already pursuing reduction efforts and welcome the opportunity for formal recognition of their efforts.
- 33/50 goals and Total Quality Management principles correspond well to voluntary industry efforts such as The Responsible Care Program organized by the Chemical Manufacturers Association.
- Pollution prevention deserves a higher priority both in industry and at EPA and can best be promoted through a voluntary program such as 33/50.
- Companies recognize their responsibilities as corporate citizens and welcome the focus that 33/50 provides to reduce releases beyond regulatory requirements.

At the same time, it is important for the success of a program such as 33/50 to understand the reasons why companies have elected *not* to participate. The reasons most often cited by companies that have been hesitant to join 33/50 are:

- The vagaries of the business cycle or of company operations make predictions about future waste generation next to impossible.

- Companies are already devoting maximum possible resources to deal with existing environmental requirements and cannot adopt additional environmental goals.

- Concern over possible conflicts between 33/50 endeavors and goals established by other federal or state environmental programs, such as reduction goals established under the Clean Air Act Amendments of 1990.

TABLE 3. SAMPLE COMPANY REDUCTION PLAN (HONDA OF AMERICA).

PROCESS	TECHNOLOGY REQUIRED	ALTERNATE TECHNOLOGY CONFIRMED	GENERAL SCHEDULE '92 '93 '94 '95 '96	ESTIMATED COST
			MY94 MY95 MY96	
Weld surface cleaning	Alternate cleaning process to replace 1,1,1 Tricloroethane without harming quality or creating associate safety concerns	No	Selection/testing of alternative processes	Unknown
Part degreasing	Vapor degreaser - driveshaft cold cleaner - valve bodies eliminate 12/91	No	Development of alternative process	$150,000 - $220,000
Spec change	Painting spec change	Yes	Ongoing trials for '92 model year	To be determined
Paint system cleaning	Addition of air/solvent purge equipment	No		$31,000 capital
Paint process modification	Modification of coating specifications	Yes	Ongoing trials for '92 model year	$40,000 - $50,000 /yr expense
Paint system cleaning solvent	Replacement of existing cleaning solvent with alternative	No	Develop plan and criteria Testing and evaluation Impact analysis	$265,000 - $1,750,000/yr expense
Paint process modification	Reformulation of coatings to reduce usage of ITP chemicals	No	Develop plan and priorities Testing and evaluation Bring formulated coatings online	Unknown
Bumper pre-treatment	Replacement of current 1,1,1 Trichloroethane system with alternative system (may also require bumper substrate modification and painting system modification)	No	Research and development of alt. technology - plasma cleaning system - substrate modification with water borne pre-treatment system - substrate modification/poser wash pre-treat alternate coating system Production line renovation	$24 million
Waterborne technology	Further replacement of solvent-borne coatings with waterborne	In process	Implementation goal - end of 1996	$75 - $200 million

■ Target date for implementation

- Constraints imposed by customers, such as military specifications for the types of chemicals and processes required to fulfill government contracts.

- Mandatory federal, state, and local permitting processes are extremely cumbersome, and the company is unwilling to pursue permit modifications that may be needed to implement 33/50 Program objectives.

EPA is examining these obstacles to learn where there is opportunity to make more companies interested in participating in 33/50. As the Program has stressed from its outset, 33/50 is not intended as a *substitute* for EPA's regulatory programs, and the Agency cannot relax regulatory oversight or enforcement as a means of encouraging participation. However, 33/50 is working carefully in concert with EPA's other programs, and with other federal agencies such as the Department of Defense, to insure maximum coordination and flexibility.

Some companies also wrote indicating that, as a holding company, partnership, or other financial arrangement with limited oversight of day-to-day operations or diverse business units, they were not the appropriate entity to decide environmental policy. The 33/50 Program is in the process of redirecting requests for participation to the individual business units at these companies.

33/50 ACTIVITIES — WHAT INDUSTRY IS DOING

A number of companies that have committed to the 33/50 Program have provided EPA with reports of their progress in meeting their reduction targets. A few of the "Top 600" company reports are summarized below. (Note: information is this section was taken directly from company reports and has not been independently verified.)

- **AT&T** (New York, New York) reports that the corporation has already achieved a 66% reduction of its 33/50 chemicals, from 6.4 million pounds of releases and transfers in 1988, to 2.1 million in 1990. The reductions were achieved through a combination of techniques, chiefly chemical substitutions and process modifications, with an emphasis on pollution prevention. Some of the reductions were also due to decreased production levels at several of the company's plants. AT&T has set additional reduction targets for all its facilities worldwide. These include: (a) 95% elimination of toxic chemical air emissions (of all TRI chemicals) by 1995, striving for 100% elimination by 2000; (b) 100% phaseout of CFC's by 1994; and (c) reducing total manufacturing process waste 25% by 1994 (see Figure 5).

- **BF GOODRICH** (Akron, Ohio) reports a 32% reduction in 33/50 chemicals between 1988 and 1990, and anticipates exceeding its reduction target of 50% by 1995.

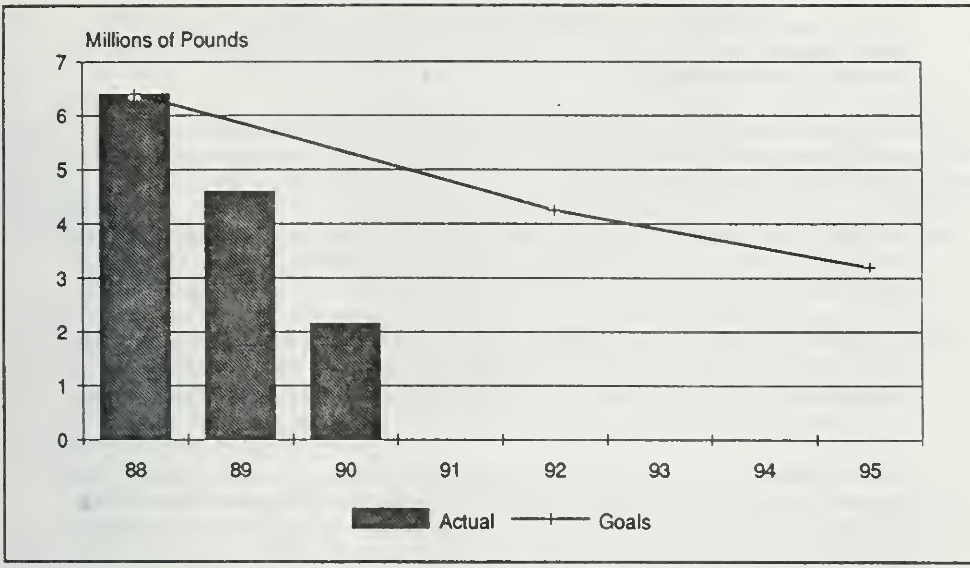


Figure 5. AT&T Reduction Goals for All Plants and Achievements to Date.

- **DOW CHEMICAL's** (Midland, Michigan) participation in the 33/50 Program includes not only the seventeen 33/50 chemicals, but all 121 TRI chemicals reported by company facilities, targeting overall reductions of 50% by 1995. Dow has reduced overall TRI quantities from 23.2 to 16.2 million pounds from 1988 to 1990, a reduction of 30%.

- **DU PONT** (Wilmington, Delaware) has created an internal corporate data base to manage information from 80 facilities in order to track progress towards its 33/50 goal of 50% reduction by 1995, as well as several other corporate goals: 60% reduction of air toxics from 1987 to 1993; 90% reduction of carcinogenic air emissions by 2000; eliminate toxic discharges to land by 2000. Between 1988 and 1990, Du Pont has reduced TRI totals of the 33/50 chemicals from 20.2 to 17.7 million pounds, a reduction of 12%.

- **ILLINOIS TOOL WORKS** (Glenview, Illinois), which operates 130 facilities in 20 states, has reduced its **use** of 33/50 chemicals by 33% between 1988 and 1990, with a consequent reduction in waste generation.

- **REPUBLIC ENGINEERED STEELS** (Massillon, Ohio) provided technical update information on its activities, including: installation of steam cleaning equipment to replace the use of trichloroethane, thus eliminating 40,000 pounds of releases; modifying capture hoods and increasing baghouse (filter) efficiencies to capture greater amounts of metallic dusts, which the company hopes to be able to reuse; creating a task force to explore means of eliminating landfilling of electric arc furnace slag.

These large companies are not alone in making reduction commitments and in keeping the 33/50 Program (and the public) up to date. Among the smaller companies that have reported on their progress are:

- **MAGEE CARPET** (Magee Industrial Enterprises of Bloomsburg, Pennsylvania) has eliminated their use of trichloroethane, thereby eliminating 340,000 pounds of releases of this chemical.

- **PINES TRAILER LIMITED PARTNERSHIP** (Chicago, Illinois) has achieved reductions from 1988 to 1990 for the two 33/50 chemicals it reports: 48% reduction for xylene, and a 37% reduction for methyl isobutyl ketone, and anticipates overall reductions of at least 50% by 1995.

- **ULTRA FORGE** (Cuyahoga Falls, Ohio) has been replacing its solvent-based vapor degreasers with spray wash equipment, thereby eliminating more than 80,000 pounds of releases of trichloroethane and tetrachloroethylene; the company anticipates total elimination of these two chemicals in 1992.

RELEASE/TRANSFER PROFILE FOR 33/50 COMMITMENT COMPANIES

At this time in the 33/50 Program's development, the information submitted to EPA by companies participating in the Program is not detailed enough to enable us to analyze fully the nature or impact of the reduction commitments themselves. We can determine, as reported above, that the quantifiable commitments made by 562 companies to date amount to a nationwide pledge of 304 million pounds of reduced toxic chemical releases and transfers by 1995. But we are not yet in a position to determine the impacts of these reduction commitments on a geographic-, medium-, chemical-, or industry-specific basis.

By and large, companies have set reduction goals to be achieved on a company-wide basis, in many instances spanning operations at facilities dispersed throughout the nation and in a variety of industrial sectors. The details of how and where these reductions actually will be achieved are still being flushed out at the plant or production process level. Until more companies have completed their internal reduction plans and communicated them to EPA, further analyses of the impacts of the reduction commitments must be put on hold.

While we cannot yet analyze the impacts of companies' reduction commitments, we can describe the TRI release/transfer profiles of the companies which have committed to the 33/50 Program. This section of the report presents a series of analyses comparing the releases and offsite transfers of 33/50 chemicals by the 734 companies committing to the 33/50 Program to the total 33/50 release/transfer universe in the 1988 baseline year.

The analyses identify the **potential** impacts of companies' reduction commitments. Readers are cautioned that the reduction efforts eventually implemented by companies may result in a distribution of release/transfer reductions that differs markedly from the distribution of the companies' overall releases and transfers. For example, a company with identical facilities in Oregon and Tennessee could achieve a 40% company-wide reduction goal in a variety of ways: by reducing releases at each facility by 40%; by reducing by 60% percent at one facility and only 20% at the other; or, achieve its corporate goal entirely by concentrating reduction efforts to achieve an 80% reduction at one facility, leaving releases and transfers at the other facility unchanged for the time being. Accordingly, the release/transfer profiles presented below are not intended to represent the reductions that will be observed in companies' future TRI reports.

As indicated in Table 1 above, facilities associated with the 734 companies making 33/50 Program commitments reported 744 million pounds of 33/50 chemical releases and transfers in the Program's baseline year. Although the participating companies overall account for approximately one half of the 1.4 billion pounds of 33/50 releases and transfers in 1988, the analyses of these committed companies' releases and transfers presented below do not reflect an even distribution from sector to sector.

STATE/EPA REGIONAL DISTRIBUTIONS

The state-by-state and EPA Regional distributions of company participation in the 33/50 Program and associated releases and transfers of the seventeen 33/50 chemicals are shown in Tables 4 and 5. The number of 33/50 companies with their headquarters located in each state or reporting jurisdiction differs considerably, ranging from zero in Alaska and the Virgin Islands to 498 in Illinois (see Table 4). The company participation rate also varies ranging from a level of no participation (Montana, Nevada, New Mexico, North Dakota, South Dakota, Vermont, Wyoming, District of Columbia, and Puerto Rico) to a high of 33% in Hawaii and 23% in both Delaware and Oregon.

The five states with the largest amounts of 33/50 releases and transfers in 1988 were Ohio, Texas, Indiana, Pennsylvania, and Michigan (see Table 5). Each accounted for over 85 million pounds and together they represented almost one-third of the 33/50 national total. In looking at the releases and transfers of facilities belonging to the committed companies, we see that the top five states were the same, but in a slightly different order: Texas, Pennsylvania, Indiana, Michigan, and Ohio. (Note that releases and transfers are assigned to the state in which facilities are located, not the state in which their parent company headquarters are located.) The percentages varied among the states from less than 5% of the total represented by committed companies to greater than 90%. However, it should be noted that the extremes were associated with states with the smallest number of TRI facilities, so that one company has a large impact on such a percentage calculation. The percentages among the top five states were closer, ranging from 49% of the total represented by facilities of committed companies in Ohio to 58% in Pennsylvania.

MEDIA/DESTINATION DISTRIBUTION

Companies must report to TRI the amounts of a chemical that are released on site and/or transferred off site. Releases consist of air emissions (fugitive and point source), surface water discharges, on-site releases to land, and discharges to underground injection wells. Transfers are either to Publicly Owned Treatment Works (POTWs) or to off-site treatment, storage, and disposal facilities. While the **releases** of a chemical to a particular medium are clear, TRI data do not show the medium or geographic location to which **transfers** are eventually released or the quantities of those releases.

For example, a chemical that is transferred to a POTW may end up being discharged to surface water or sent in sewage sludge to a landfill (or released to the air through vaporization). The chemical wastes sent off-site to a treatment, storage, and disposal facility end up at a different geographic location and may be treated and reduced in amount by methods varying widely from chemical to chemical, and facility to facility. These differences should be kept in mind when looking at the amount of releases to the various media.

The distribution of releases and transfers by media/transfer destination for committed companies and other 33/50 companies can be seen in Figure 6 and Table 6. As shown, the 33/50 releases and transfers of committed companies differ significantly on a percentage basis between media and transfer destination. For example, in 1988 the 33/

TABLE 4. COMPANY PARTICIPATION IN 33/50 PROGRAM, BY STATE AND EPA REGION

STATE	NUMBER OF COMPANIES IN 33/50 UNIVERSE (Number)	NUMBER OF COMPANIES MAKING 33/50 COMMITMENTS (Number)	NUMBER OF COMPANIES MAKING 33/50 COMMITMENTS AS PERCENT OF TOTAL IN STATE/REGION (Percent)
REGION I			
Connecticut	215	32	14.88
Maine	17	1	5.88
Massachusetts	253	16	6.32
New Hampshire	50	7	14.00
Rhode Island	84	3	3.57
Vermont	10	0	0.00
Region Total	629	59	9.38
REGION II			
New Jersey	325	44	13.54
New York	443	69	15.58
Puerto Rico	24	0	0.00
Virgin Islands	0	0	—
Region Total	792	113	14.27
REGION III			
Delaware	22	5	22.73
District of Columbia	8	0	0.00
Maryland	35	4	11.43
Pennsylvania	332	55	16.57
Virginia	113	15	13.27
West Virginia	13	2	15.38
Region Total	523	81	15.49
REGION IV			
Alabama	73	8	10.96
Florida	99	8	8.08
Georgia	101	14	13.86
Kentucky	63	7	11.11
Mississippi	35	4	11.43
North Carolina	134	14	10.45
South Carolina	63	6	9.52
Tennessee	89	8	8.99
Region Total	568	69	12.15
REGION V			
Illinois	498	61	12.25
Indiana	197	26	13.20
Michigan	260	42	16.15
Minnesota	116	18	15.52
Ohio	426	68	15.96
Wisconsin	224	32	14.29
Region Total	1,721	247	14.35
REGION VI			
Arkansas	26	4	15.38
Louisiana	31	4	12.90
New Mexico	4	0	0.00
Oklahoma	44	7	15.91
Texas	274	35	12.77
Region Total	379	50	13.19
REGION VII			
Iowa	61	4	6.56
Kansas	37	1	2.70
Missouri	161	15	9.32
Nebraska	28	1	3.57
Region Total	287	21	7.32
REGION VIII			
Colorado	49	5	10.20
Montana	3	0	0.00
North Dakota	6	0	0.00
South Dakota	6	0	0.00
Utah	21	3	14.29
Wyoming	1	0	0.00
Region Total	86	8	9.30
REGION IX			
Arizona	50	4	8.00
California	460	56	12.17
Hawaii	3	1	33.33
Nevada	6	0	0.00
Region Total	519	61	11.76
REGION X			
Alaska	0	0	—
Idaho	6	1	16.67
Oregon	60	14	23.33
Washington	86	10	11.63
Region Total	152	25	16.45
OUTSIDE U.S. OWNERSHIP	2	0	0.00
TOTAL	5,747	734	12.77

TABLE 5. RELEASES AND TRANSFERS OF 33/50 CHEMICALS, BY STATE AND EPA REGION, 1988

STATE	RELEASES/TRANSFERS OF ALL 33/50 CHEMICALS (Pounds)	RELEASES/TRANSFERS ASSOCIATED WITH COMPANIES MAKING COMMITMENTS (Pounds)	RELEASES/TRANSFERS ASSOCIATED WITH COMPANIES MAKING 33/50 COMMITMENTS AS PERCENT OF STATE/REGIONAL TOTAL (Percent)
REGION I			
Connecticut	28,761,305	11,774,886	40.94
Maine	5,866,262	3,904,154	66.55
Massachusetts	26,469,403	14,374,124	54.30
New Hampshire	9,144,265	4,772,812	52.19
Rhode Island	6,178,734	1,306,084	21.14
Vermont	1,502,495	202,386	13.47
Region total	77,922,464	38,334,446	48.63
REGION II			
New Jersey	40,145,307	19,168,291	47.75
New York	70,817,814	42,416,031	59.89
Puerto Rico	9,695,688	8,810,397	90.87
Virgin Islands	1,468,980	0	0.00
Region total	122,127,789	70,394,719	57.64
REGION III			
Delaware	3,752,990	2,235,556	59.57
District of Columbia	0	0	–
Maryland	9,676,045	5,435,313	56.17
Pennsylvania	87,844,154	50,948,249	58.00
Virginia	38,529,040	19,988,619	51.88
West Virginia	12,794,018	8,290,712	64.80
Region total	152,596,247	86,898,449	56.95
REGION IV			
Alabama	36,758,750	23,258,269	63.27
Florida	17,248,263	6,388,575	37.04
Georgia	38,148,497	18,920,634	49.60
Kentucky	30,693,456	13,529,034	44.08
Mississippi	31,009,064	12,886,751	41.58
North Carolina	81,896,442	25,490,977	41.18
South Carolina	28,152,948	14,768,375	52.45
Tennessee	40,701,783	15,392,654	37.82
Region total	284,609,203	130,633,269	45.90
REGION V			
Illinois	71,817,104	23,843,367	33.29
Indiana	92,013,726	50,552,011	54.94
Michigan	84,873,345	48,372,378	56.99
Minnesota	40,118,538	30,706,931	76.54
Ohio	96,392,100	46,978,964	48.74
Wisconsin	35,164,828	11,024,548	31.35
Region total	420,179,841	211,478,199	50.33
REGION VI			
Arkansas	22,582,184	8,644,790	38.28
Louisiana	23,309,971	17,527,678	75.19
New Mexico	1,890,219	444,873	23.54
Oklahoma	17,484,903	6,193,305	35.42
Texas	93,665,640	52,695,978	56.26
Region total	158,932,917	85,506,624	63.80
REGION VII			
Iowa	25,246,654	14,473,219	57.33
Kansas	13,339,907	7,690,789	57.65
Missouri	44,085,040	24,898,011	56.48
Nebraska	9,829,564	6,654,764	67.70
Region total	92,601,165	53,718,783	58.07
REGION VIII			
Colorado	8,375,774	3,231,059	50.68
Montana	2,856,267	2,659,345	93.11
North Dakota	798,622	241,436	30.23
South Dakota	1,581,978	995,370	63.72
Utah	9,089,633	7,386,118	81.26
Wyoming	953,940	676,595	70.93
Region total	21,636,204	15,189,921	70.21
REGION IX			
Arizona	11,867,813	7,211,582	60.77
California	63,291,813	30,603,202	48.35
Hawaii	390,367	187,562	48.05
Nevada	698,020	34,114	4.89
Region total	76,248,003	38,036,460	49.89
REGION X			
Alaska	336,555	13,740	4.08
Idaho	1,024,902	871,438	85.03
Oregon	8,526,830	5,391,129	63.23
Washington	14,536,710	9,449,016	65.00
Region total	24,424,997	15,725,323	64.38
TOTAL	1,431,178,630	743,914,193	51.98

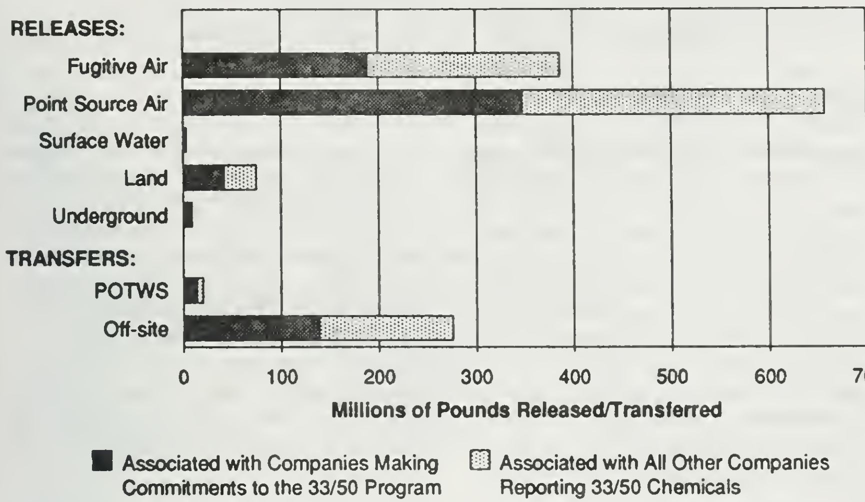


Figure 6. Releases and Transfers of 33/50 Chemicals by Media/Transfer Destination, 1988.

TABLE 6. RELEASES AND TRANSFERS OF 33/50 CHEMICALS BY MEDIA/TRANSFER DESTINATION, 1988

MEDIA/TRANSFER DESTINATION	RELEASES/ TRANSFERS OF ALL 33/50 CHEMICALS (Pounds)	RELEASES/TRANSFERS ASSOCIATED WITH COMPANIES MAKING COMMITMENTS (Pounds)	RELEASES/TRANSFERS ASSOCIATED WITH COMPANIES MAKING COMMITMENTS AS PERCENT OF MEDIA/ TRANSFER TOTAL (Percent)
Total Air Releases	1,044,819,113	536,933,395	51.39
Fugitive	386,587,300	189,110,023	48.92
Point Source	658,231,813	347,823,372	52.84
Surface Water Discharges	4,000,323	3,086,128	77.15
Land Releases	75,606,883	42,493,826	56.20
Underground Injection	9,344,343	7,595,544	81.28
Total Releases	1,133,770,662	590,108,893	52.05
Transfers to POTWS	20,892,597	14,229,849	68.11
Other Off-site Transfers	276,515,371	139,575,451	50 48
Total Transfers	297,407,968	153,805,300	51 72
Total Releases/Transfers	1,431,178,630	743,914,193	51 98

50 discharges to underground injection wells of facilities of committed companies represented 81% of all 33/50 discharges to such wells. In contrast, the 33/50 fugitive air emissions of committed companies accounted for 49% of total 33/50 fugitive air emissions.

INDUSTRY SECTOR DISTRIBUTION

The seventeen 33/50 chemicals are used by facilities manufacturing a wide range of goods, from the chemicals themselves to electronic equipment, paper, plastics, food, and furniture. Each of the industrial sectors that are required to report to TRI (the manufacturing Standard Industrial Classification (SIC) codes 20 through 39) have reported releases and transfers of the 33/50 chemicals. The distribution of companies' 33/50 Program participation rates across major industrial sectors are presented in Figure 7 and Table 7. The distribution of TRI-reported releases and transfers of 33/50 chemicals by facilities associated with these companies is presented in Figure 8 and Table 8. (The category called "multiple" represents individual facilities that use the chemical in the manufacture of products in more than one of the industrial sectors listed.) The amounts of releases and transfers are assigned to an industry sector according to how the chemical is used at an individual facility, which may in some cases be different than the primary industrial sector for the company as a whole.

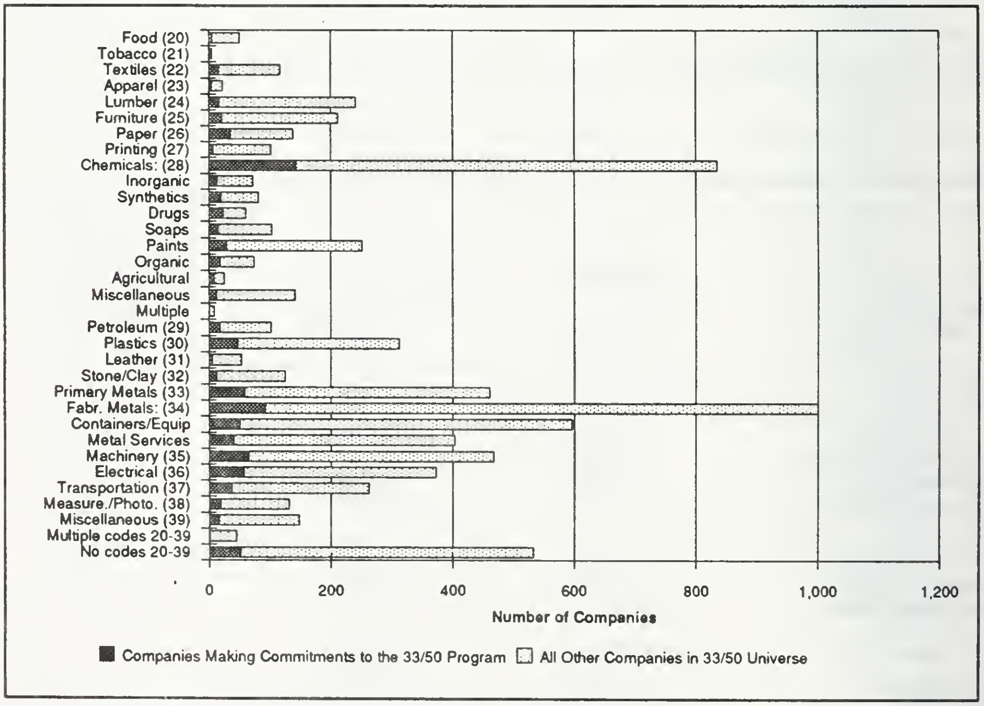


Figure 7. Company Participation in 33/50 Program, by Industry Sector.

The number of companies associated with 33/50 chemicals per industry sector ranged from a low of six in the tobacco industry to a high of 1,001 in the fabricated metals industry. The chemical sector had the second largest number of potential 33/50 companies with a total of 835. Together, the fabricated metals and the chemical industries accounted for approximately one-third of all potential 33/50 companies. (Subdivisions within these two industry sectors are shown.) The participation rate differed from sector to sector ranging from a low of approximately 2% for the "multiple codes" sector to 37% for drug/pharmaceutical manufacturers, a subdivision within the chemical sector (see Figure 7 and Table 7).

TABLE 7. COMPANY PARTICIPATION IN 33/50 PROGRAM, BY INDUSTRY SECTOR

SIC CODE	INDUSTRY SECTOR	NUMBER OF COMPANIES IN 33/50 UNIVERSE (Number)	NUMBER OF COMPANIES MAKING 33/50 COMMITMENTS (Number)	NUMBER OF COMPANIES MAKING 33/50 COMMITMENTS AS PERCENT OF TOTAL (Percent)
20	Food	51	6	11.76
21	Tobacco	6	2	33.33
22	Textiles	117	16	13.68
23	Apparel	23	4	17.39
24	Lumber	242	17	7.02
25	Furniture	212	22	10.38
26	Paper	139	35	25.18
27	Printing	102	7	6.86
28	Chemicals	835	143	17.13
	Industrial Inorganic Chemicals	73	14	19.18
	Plastic Materials/Synthetics	82	20	24.39
	Drugs	61	23	37.70
	Soaps/Cleaners	104	15	14.42
	Paints	262	29	11.07
	Industrial Organic Chemicals	75	19	25.33
	Agricultural Chemicals	26	9	34.62
	Miscellaneous Chemicals	142	13	9.15
	Multiple Chemical Products	10	1	10.00
29	Petroleum Refining	102	18	17.65
30	Rubber/Plastic Products	313	47	15.02
31	Leather	54	6	11.11
32	Stone/Clay/Glass	125	13	10.40
33	Primary Metals	462	59	12.77
34	Fabricated Metals	1,001	92	9.19
	Metal Containers/Equipment/Others	597	51	8.54
	Metal Services	404	41	10.15
35	Machinery, except Electrical	468	65	13.89
36	Electrical/Electronic Equipment	373	57	15.28
37	Transportation Equipment	263	37	14.07
38	Measuring/Photographic Equipment	132	19	14.39
39	Miscellaneous Manufacturing	148	16	10.81
	Multiple Manufacturing Products	45	1	2.22
	Other (non-manufacturing)	534	52	9.74
TOTAL		5,747	734	12.77

While the uses of 33/50 chemicals by the chemical and transportation equipment sectors were associated with the largest releases and transfers, the highest percentages of a sector's releases and transfers that were associated with committed companies came from the drug/pharmaceutical manufacturers and the food industry (over 81%). On the other hand, the printing and metal services industries had the lowest proportion (less than 10%) of their releases and transfers associated with committed companies. (See Figure 8 and Table 8.)

TABLE 8. 33/50 PROGRAM RELEASES AND TRANSFERS, BY INDUSTRY SECTOR, 1988

SIC CODE	INDUSTRY SECTOR	RELEASES/ TRANSFERS OF ALL 33/50 CHEMICALS (Pounds)	RELEASES/TRANSFERS ASSOCIATED WITH COMPANIES MAKING COMMITMENTS (Pounds)	RELEASES/TRANSFERS ASSOCIATED WITH COMPANIES MAKING 33/50 COMMITMENTS AS PERCENT OF SECTOR TOTAL (Percent)
20	Food	6,966,684	5,649,713	81.10
21	Tobacco	262,226	0	—
22	Textiles	31,319,873	10,569,999	33.75
23	Apparel	1,051,544	308,458	29.33
24	Lumber	20,359,743	7,785,785	38.24
25	Furniture	46,114,984	12,323,456	26.72
26	Paper	82,431,820	50,677,929	61.48
27	Printing	60,187,632	5,603,890	9.31
28	Chemicals	271,096,114	190,284,148	70.19
	Industrial Inorganic Chemicals	25,171,688	9,954,080	39.54
	Plastic Material/Synthetics	27,929,058	21,117,580	75.61
	Drugs	39,462,007	35,690,927	90.44
	Soaps/Cleaners	1,910,691	694,347	36.34
	Paints	36,129,326	20,109,698	55.66
	Industrial Organic Chemicals	42,948,898	30,645,749	71.35
	Agricultural Chemicals	5,407,499	3,605,472	66.68
	Miscellaneous Chemicals	11,599,140	3,976,690	34.28
	Multiple Chemical Products	80,537,807	64,489,605	80.07
29	Petroleum Refining	37,718,098	26,102,758	69.20
30	Rubber/Plastic Products	99,349,626	35,139,571	35.37
31	Leather	11,051,613	3,655,424	33.08
32	Stone/Clay/Glass	17,280,661	8,988,425	52.01
33	Primary Metals	133,958,316	76,618,761	57.20
34	Fabricated Metals	101,269,676	24,048,780	23.75
	Metal Containers/Equipment/Other	78,221,021	22,013,831	28.14
	Metal Services	23,048,655	2,034,949	8.83
35	Machinery, except Electrical	49,683,360	15,038,035	30.27
36	Electrical/Electronic Equipment	96,525,335	54,115,545	56.06
37	Transportation Equipment	153,086,367	93,756,375	61.24
38	Measuring/Photographic Equipment	38,183,002	29,489,127	77.23
39	Miscellaneous Manufacturing	28,091,881	6,402,492	22.79
	Multiple Manufacturing Products	138,934,411	86,026,076	61.92
	Other (non-manufacturing)	6,255,664	1,329,446	21.25
TOTAL		1,431,178,630	743,914,193	51.98

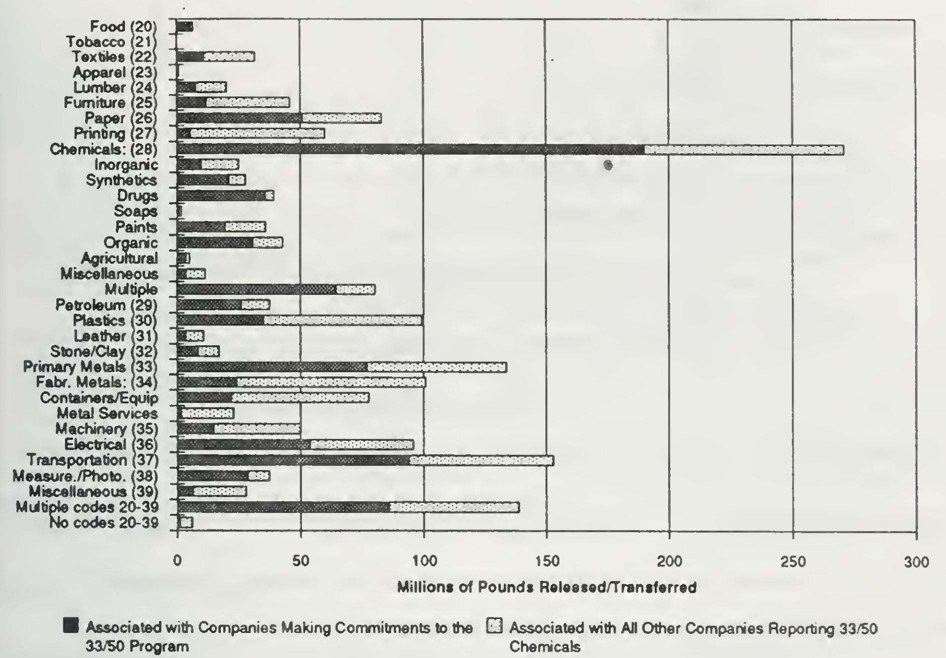


Figure 8. Releases and Transfers of 33/50 Chemicals, by Industry Sector, 1988.

CHEMICAL DISTRIBUTION

Analysis of TRI-reported releases and transfers on a chemical-specific basis also reveals varying levels of "coverage" by companies currently participating in the 33/50 Program, ranging from a high of nearly 93% for mercury and its compounds to a low of just over 40% for chromium and related compounds (see Figure 9 and Table 9). Ubiquitous chemicals with larger volumes of TRI releases and transfers, such as toluene (almost twice as large as any of the others) and trichloroethane, have lower portions of their total volume associated with companies participating in the 33/50 Program, highlighting the need to continue program outreach efforts aimed at bringing the numerous smaller users and manufacturers into the Program.

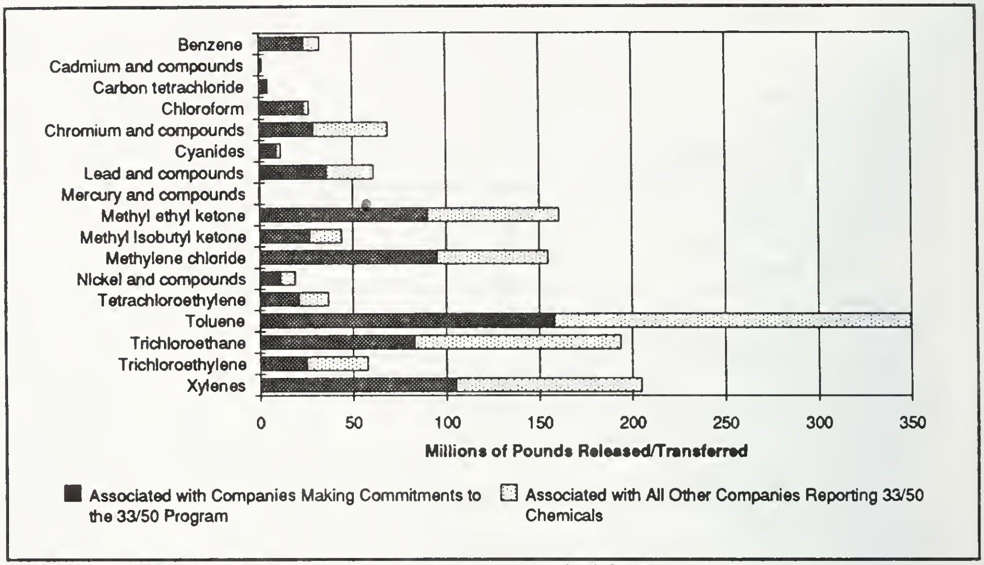


Figure 9. Releases and Transfers of 33/50 Chemicals, by Chemical, 1988.

TABLE 9. RELEASES AND TRANSFERS OF 33/50 CHEMICALS, BY CHEMICAL, 1988

CHEMICAL	RELEASES/ TRANSFERS OF ALL 33/50 CHEMICALS (Pounds)	RELEASES/TRANSFERS ASSOCIATED WITH COMPANIES MAKING COMMITMENTS (Pounds)	RELEASES/TRANSFERS ASSOCIATED WITH COMPANIES MAKING 33/50 COMMITMENTS AS PERCENT OF TOTAL FOR CHEMICAL (Percent)
Benzene	32,240,533	23,541,686	73.02
Cadmium and compounds	1,928,819	940,346	48.75
Carbon tetrachloride	5,029,696	4,519,278	89.85
Chloroform	26,882,013	23,708,139	88.19
Chromium and compounds	68,793,835	29,144,969	42.37
Cyanides	11,787,893	9,273,102	78.67
Lead and compounds	60,774,417	36,188,398	59.55
Mercury and compounds	318,587	295,835	92.86
Methyl ethyl ketone	161,203,453	90,182,171	55.94
Methyl isobutyl ketone	44,511,920	27,427,490	61.62
Methylene chloride	155,059,038	95,512,513	61.60
Nickel and compounds	19,289,876	11,388,249	59.04
Tetrachloroethylene	37,760,219	21,313,079	56.44
Toluene	349,388,787	157,864,903	45.18
Trichloroethane	194,137,772	82,928,321	42.72
Trichloroethylene	57,816,129	25,092,853	43.40
Xylenes	204,255,643	104,592,861	51.21
TOTAL	1,431,178,630	743,914,193	51.98

33/50 AFTER ONE YEAR — MAKING PROGRESS?

After one year of outreach efforts to solicit company commitments, almost half of the nation's largest releasers of 33/50 chemical wastes have submitted reduction commitments (275 out of 555 companies). Over 450 companies from the ranks of the 5,192 companies with samller releases and tranfers of 33/50 chemicals have signed on, although they have had less time to formally consider their participation in the Program.

Is the 33/50 glass half empty or half full? If all 734 companies that have committed to the Program were to completely eliminate their TRI discharges of the seventeen 33/50 chemicals by 1995, they would have reduced the nation's waste load by more than 700 million pounds, meeting the 33/50 Program goal of a 50% reduction.

In fact, most of these companies have agreed to commitments of about 50% by 1995, with the result that the 33/50 Program still has to make substantial inroads on the generation of toxic pollution if it is to meet its reduction goals. On the encouraging side is the early indication that many companies have indicated that they expect to exceed — often by large amounts — their reduction targets; this has already occurred at AT&T (see **What Industry Is Doing**, above). On the other hand, there still remain the hundreds of large generators, and thousands of smaller ones, who, for whatever reasons, have not yet elected to participate. Our efforts to bring them on board will continue as the 33/50 Program matures.

33/50: WHAT LIES AHEAD?

The 33/50 Program has grown substantially in its first year, expanding from its initial face-to-face meetings with a few dozen companies and targeted contacts with the "Top 600" companies with the largest reports of 33/50 wastes, to broad outreach — orchestrated through EPA's ten Regional offices and involving several State agencies as well — to the thousands of companies who can assist us in achieving the Program's goals.

In the next few years, as we approach the 1995 target date, the focus of 33/50 will shift from outreach to evaluation and recognition. How much reduction has been achieved? What has been the impact of pollution prevention practices? One of the keys for answering these and other questions will be new information provided by the **Pollution Prevention Act of 1990**. The Act calls for additional data collection in TRI which will address the role of pollution prevention, recycling, and treatment in achieving reductions. The Act will also require all companies — not just 33/50 participants — to project their next two years' waste generation for the TRI chemicals, a source of data that will allow an early assessment of expected waste generation trends. The new pollution prevention data will first be reported to EPA and the States in July, 1992, covering the 1991 reporting year.

With this new information and the details that companies are voluntarily providing to the 33/50 Program, future Progress Reports and other communications will provide a realistic assessment of how successfully U.S. Industry is able to apply pollution prevention to the reduction of releases and transfers of the seventeen 33/50 chemicals in the context of a voluntary reduction effort.

APPENDIX A

Companies Committing to the 33/50 Program
(February, 1992)

This appendix provides a list of all companies that have indicated to EPA in writing as of February, 1992, that they intend to participate in the 33/50 Program. In many cases, subsidiary companies responded in addition to or in place of parent companies. In such instances, subsidiaries are listed indented underneath their parent company. All subsidiary companies are also listed in their own alphabetic order, with their parent company indicated in parentheses. State abbreviations are provided only for parent companies, indicating the location of their headquarters operations.

APPENDIX A—Companies Making Commitments to the 33/50 Program (February, 1992)

COMPANY	STATE
3M CO	MN
A B C COMPOUNDING COMPANY INC	GA
A B CHANCE CO	MO
A J INDUSTRIES INC	CA
SARGENT-FLETCHER	
A T CROSS CO	RI
A T R WIRE & CABLE CO	KY
A W CHESTERTON CO	MA
AACCO FOUNDRY INC	CA
ABBOTT LABORATORIES	IL
ACC HOLDINGS CORP	PA
ARISTECH CHEMICAL	
ACME ENGINEERING & MANUFACTURING	OK
ACME SPONGE & CHAMOIS CO	FL
ACME STEEL CO	IL
ACTION PLATING CORP	FL
ADAC PLASTICS	MI
ADVANCED CIRCUIT TECHNOLOGY	NH
ADVANCED FRICTION MATERIALS	MI
AERO METAL FINISHING INC	MO
AEROFIL TECHNOLOGY INC	MO
AEROFORGE CORP	IN
AEROTHRUST CORP	FL
AEROVOX (COOPER INDUSTRIES)	
AIR PRODUCTS AND CHEMICALS	PA
AKRON PAINT & VARNISH INC	OH
AKZO CHEMICALS (AMERICA AKZO)	
ALABAMA RIVER PULP	
(PARSONS & WHITTEMORE ENTERPRISES)	
ALADDIN INDUSTRIES INC	TN
ALDAN RUBBER CO	PA
ALL METAL STAMPINGS INC	WI
ALLEGHENY LUDLUM CORP	PA
ALLEN-BRADLEY CO	OK
ALLIED MINERAL PRODUCTS INC	OH
ALLIED-SIGNAL INC	NJ
ALUMINUM COMPANY OF AMERICA	PA
AMERICA AKZO INC	NY
AKZO CHEMICALS	
AMERICAN & EFIRD (RUDDICK CORP)	
AMERICAN CAST IRON PIPE CO	AL
AMERICAN CYANAMID CO	NJ
AMERICAN ELECTRIC COMPONENTS	IN
AMERICAN PETROFINA HOLDING	TX
FINA OIL AND CHEMICAL	
AMERICAN SAFETY RAZOR (JORDAN GROUP)	
AMERICAN STANDARD (KELSO ASI PARTNERS)	
AMERICAN SYNTHETIC RUBBER CORP	KY
AMERICAN TELEPHONE & TELEGRAPH	NY
AMERICAN TOY AND FURNITURE CO	WI
AMERON INC	CA
AMITY LEATHER PRODUCTS CO	WI
AMOCO CORP	IL
AMSTED INDUSTRIES INC	IL
AMWAY CORP	MI
ANABOLIC INC	CA
ANDERSEN CORP	MN
ANDERSON SCREW PRODUCTS INC	NY
ANHEUSER-BUSCH CO	MO
ANOMATIC CORP	OH
ARCADIAN CORP	TN
ARCHER CO (RJR NABISCO HOLDINGS)	
ARCO PRODUCTS (ATLANTIC RICHFIELD)	
ARISTECH CHEMICAL (ACC HOLDINGS)	
ARKWIN INDUSTRIES INC	NY
ARMCO STEEL CO LP	OH
ARMORED KNIGHT CORP	IL
CFC INTERNATIONAL	
ARMSTRONG WORLD INDUSTRIES	PA
ARROW ENGINEERING INC	GA
ARROW INTERNATIONAL INC	PA
ARTISTIC POLISHING & PLATING	CA
ASARCO INC	NY
ASEA BROWN BOVERI INC	CT
ASHLAND OIL INC	KY
ASSET MANAGEMENT ASSOCIATES	NY
CHILDERS PRODUCT CO	
ASTRAL INDUSTRIES INC	IN
ATLANTIC RICHFIELD CO	CA
ARCO PRODUCTS	
ATOCHEM (ELF AQUITAINE)	
AUBURN FOUNDRY INC	IN
AUTO-SWAGE PRODUCTS INC	CT
AUTOMATA INC	VA
AUTOMATIC PLATING OF BRIDGEPORT	CT
AUTOMATIC WELDING & MANUFACTURING	OH
AUTOMATION PLATING CORP	CA
AVESTA SANDVIK TUBE AB	FL
AVON NORTH AMERICA INC	MI
CADILLAC RUBBER & PLASTIC	
AVONDALE INDUSTRIES INC	LA
B F GOODRICH CO	OH
B L DOWNEY CO	IL
BAIRNCO CORP	FL
REINHOLD	

COMPANY	STATE
BAKER HUGHES INC	TX
BGA INTERNATIONAL	
BALDOR ELECTRIC CO	AR
BALL SOCKET MANUFACTURING	CT
BARNETT VARNISH (OAK PARTNERS)	
BARNHARDT MANUFACTURING CO	NC
BASF CORP	NJ
BASS PLATING CO	CT
BASSETT FURNITURE INDUSTRIES	VA
BATH IRON WORKS	ME
BAXTER INTERNATIONAL INC	IL
BAYER USA INC	PA
BAYOU STEEL	LA
BELL & HOWELL CO	IL
BEMIS COMPANY INC	MN
BENJAMIN MOORE & CO	NJ
BENNETT MANUFACTURING CO	NY
BENSON MANUFACTURING	WI
BENTON INTERNATIONAL INC	CT
CIRCUIT WISE	
BESLY PRODUCTS CORP	IL
BEST CHAIRS	IN
FISCHER CHAIR	
BETHLEHEM STEEL CORP	PA
BGA INTERNATIONAL (BAKER HUGHES)	
BIMAC (CHEMINCON)	
BIRD ELECTRONIC CORP	OH
BLACK & DECKER CORP	MD
BLASER DIE CASTING CO	WA
CONTINENTAL BRASS	
BLOOMSBURG MILLS (PENN COLUMBIA)	
BLUE CIRCLE AMERICA INC	GA
BLUE RIDGE PRODUCTS CO	NC
BLUE STREAK FINISHERS LTD	WA
BOEHRINGER INGELHEIM	CT
BOEING CO	WA
BOISE CASCADE CORP	ID
BOLLMAN HAT CO	PA
BOMARKO INC	IN
BONDLINE ADHESIVES INC	IN
BONIDE PRODUCTS INC	NY
BORDEN INC	NY
BOWATER INC	CT
BP AMERICA INC	OH
BRISTOL-MYERS SQUIBB CO	NY
BROD & MCCLUNG-PACE CO	OR
BRUDERER INC	AL
BRULIN & COMPANY INC	IN
BUCKSTAFF CO	WI
BULK MOLDING COMPOUNDS INC	IL
BURKE MILLS INC	NC
BURMAH CASTROL HOLDINGS	NY
CHEM-TREND	
BURR-BROWN CORP	AZ
BURRELL-LEDER BELTECH (UNITED SILK MILLS)	
BURROUGHS WELLCOME CO	NC
BUSHWICK CAN	NY
C F & I STEEL CORP	CO
C P G INTERNATIONAL INC	CA
CLEARPRINT	
C P INC	IN
C P S CHEMICAL CO	NJ
C R L INC	IL
CAAP CO	CT
CABOT CORP	MA
CADDOCK ELECTRONICS INC	CA
CADILLAC RUBBER & PLASTIC (AVON NORTH AMERICA)	
CALGON CARBON CORP	PA
CALIG STEEL DRUM CO	PA
CALSONIC INTERNATIONAL INC	CA
CAMEO MARBLE (LOUISVILLE TILE DISTRIBUTORS)	
CANON BUSINESS MACHINES INC	CA
CAPITAL RESIN CORP	OH
CAPITOL PRODUCTS CO	CT
CARD PAK INC	OH
CARGILL DETROIT CORP	MI
CARPENTER TECHNOLOGY CORP	PA
CARTER-WALLACE INC	NY
CASCADE CABINET CORP	WA
CASKET SHELLS INC	PA
CASPIAN INC	CA
CENTRAL PLASTIC CO	OK
CERA-MITE CORP	WI
CERTAINTEED CORP	PA
CFC INTERNATIONAL (ARMORED KNIGHT)	
CHAMPION INTERNATIONAL CORP	CT
CHAMPION PARTS INC	IL
CHAPARRAL STEEL (TEXAS INDUSTRIES)	
CHAS H LILLY CO	OR
CHEM-TECH LTD	IA
CHEM-TECH RUBBER	CT
CHEM-TREND (BURMAH CASTROL HOLDINGS)	
CHEMICAL SOLVENTS INC	OH
CHEMICAL SYSTEMS INC	IL

APPENDIX A—Companies Making Commitments to the 33/50 Program (February, 1992)

COMPANY	STATE
CHEMINCON INC	MI
BIMAC	
CHESTNUT RIDGE FOAM INC	PA
CHEVRON CORP	CA
CHICAGO ADHESIVE PRODUCTS CO	IL
CHILDERS PRODUCT	
(ASSET MANAGEMENT ASSOCIATES)	
CIBA-GEIGY CORP	NY
CIBRO PETROLEUM BRONX INC	NY
CIRCUIT WISE (BENTON INTERNATIONAL)	
CITGO PETROLEUM CORP	OK
CITICORP	NY
SYBRON CHEMICALS	
CLARK OIL & REFINING CORP	IL
CLEARPRINT (C P G INTERNATIONAL)	
CMC STEEL GROUP (COMMERCIAL METALS)	
COACH & CAR EQUIPMENT CORP	IL
COATING PLACE INC	WI
COATING SYSTEMS INC	NH
COLEMAN OUTDOOR PRODUCTS	
(MACANDREWS FORBES HOLDINGS)	
COLLIS INC	IA
COLORADO PAINT CO	CO
COLUMBIA CORRUGATED BOX CO	OR
COMMERCIAL ENAMELING CO	CA
COMMERCIAL METALS CO	TX
CMC STEEL GROUP	
COMO PLASTICS (G L INDUSTRIES OF INDIANA)	
CONAGRA INC	NE
UNITED AGRI PRODUCTS	
CONDERE CORP	CT
CONGOLEUM (HILLSIDE CAPITAL)	
CONTINENTAL BRASS (BLASER DIE CASTING)	
CONTRAN CORP	TX
KEYSTONE STEEL & WIRE	
COOPER INDUSTRIES INC	TX
COOPER INDUSTRIES INC	
AEROVOX	
CORNING INC	NY
CORONET PAPER CORP	NJ
CREATIVE FOAM CORP	MI
CRITERION CATALYST LTD PARTNERSHIP	TX
CROMPTON & KNOWLES CORP	CT
CROWN CORK & SEAL CO	PA
CROWN METAL FINISHING CO	NJ
CROWN ROLL LEAF INC	NJ
CRYSTAL CABINET WORKS INC	MN
CRYSTAL SPRINGS PRINTWORKS	GA

COMPANY	STATE
CUSTOM PRODUCTS CORP	WI
CYCLOPS INDUSTRIES INC	PA
D S M CHEMICALS (D S M FINANCE)	
D S M FINANCE US	DE
D S M CHEMICALS	
DALLAS WOODCRAFT (HOME INTERIORS & GIFTS)	
DALTON FOUNDRIES INC	IN
DAVIS & HEMPHILL	MD
DAY & ZIMMERMAN/BASIL	PA
DECOR GRAVURE	
(RIVER CAPITAL PARTNERS I)	
DEFT INC	CA
DEGUSSA CORP	NJ
DEL-CRAFT (KEY PLASTICS)	
DELTA ENGINEERING & MANUFACTURING	OR
DELTA RESINS & REFRACTORIES	WI
DERBY MANUFACTURING INC	OH
DESIGN HOUSE	WI
DIAL CORP	AZ
DIEBOLD INC	OH
DISPLAY PACK INC	MI
DISSTON CO	VA
DITRI ASSOCIATES INC	CT
RIDG-U-RACK	
DITTLER BROTHERS	GA
DOCK RESINS CORP	NJ
DOE RUN CO	MO
DOFASCO INC	MI
WHITTAR STEEL STRIP	
DONALDSON CO	MN
DORMA DOOR CONTROLS INC	PA
DOUGLAS & LOMASON CO	MI
DOW CHEMICAL CO	MI
DOW CHEMICAL CO	
MARION MERRELL DOW	
DU PONT	DE
DUKANE CORP	IL
DUNCAN FINANCIAL CORP	CA
DUNDEE MILLS INC	GA
DUNLOP TIRE CORP	NY
DUO-FAST CORP	IL
DURACELL INTERNATIONAL INC	CT
E F HOUGHTON & CO	PA
E R MOORE CO	IL
EAGLE CHEMICALS INC	OH
EAGLE OTTAWA LEATHER	
(SMITH EVERETT INV LTD)	
EAGLE-PICHER INDUSTRIES INC	OH

COMPANY	STATE
EAST LIBERTY ELECTROPLATING	PA
EASTMAN KODAK CO	NY
EASTON FOAM INC	PA
EATON CORP	OH
EBONEX INC	NY
EBONITE INTERNATIONAL INC	KY
EKLUND METAL TREATING INC	IL
ELASTOMERIC TECHNOLOGIES INC	PA
ELECTRONIC CHROME CO	CA
ELECTROTEK CORP	WI
ELF AQUITAINE INC	NY
ELF AQUITAINE INC	
ATOCHEM	
ELI LILLY AND CO	IN
ELJO PRODUCTS INC	NJ
ELPACO COATINGS CORP	IN
EMERALD ACQUISITION CORP	IL
VISKASE	
EMERALD PACKAGING INC	CA
EMERSON ELECTRIC CO	MO
ENGELHARD CORP	NJ
EPEC INC	MA
ERDLE PERFORATING CO	NY
ERICSSON-GE MOBILE COMMUNICATION	NJ
ESAB GROUP INC	SC
ESSEX (MORGAN STANLEY LEV EQ FUND II)	
ETHYL CORP	VA
EVANITE FIBER (FORSCH LTD)	
EXCELL POLISHING & BUFFING CO	OH
EXCELLO SPECIALTY CO	OH
EXXON CORP	TX
F C HOLDINGS INC	VA
I R INTERNATIONAL	
F W WINTER (ZIMMERMAN HOLDINGS)	
FABRALLOY (STOLPER INDUSTRIES)	
FACILE HOLDINGS INC	NJ
FARLEY INC	IL
FARM & INDUSTRIAL CHEMICAL	
(MAYO CHEMICAL)	
FASCO INDUSTRIES INC	IL
FEDERAL PAPER BOARD CO	NJ
FEDERAL-MOGUL CORP	MI
FEIN CONTAINER CORP	NJ
FERNCO INC	MI
FIFTH DIMENSION INC	NJ
FINA OIL AND CHEMICAL	
(AMERICAN PETROFINA HOLDING)	
FINITE INDUSTRIES INC	NJ
FIRST CHEMICAL (FIRST MISSISSIPPI)	
FIRST MISSISSIPPI CORP	MS
FIRST CHEMICAL	
FISCHER CHAIR (BEST CHAIRS)	
FISONS CORP	NY
FLEET AEROSPACE INC	CA
FLEET AEROSPACE INC	
LANGLEY CORP	
FLETCHER PAPER CO	MI
FLEXCON COMPANY INC	MA
FLEXFAB INC	MI
FLEXONICS (ZIMMERMAN HOLDINGS)	
FLEXSTEEL INDUSTRIES INC	IA
FMC CORP	IL
FORD MOTOR CO	MI
FORSCH LTD	GA
EVANITE FIBER	
FOTO MARK INC	MN
FOXBORO (SIEBE INC)	
FRANKLIN INDUSTRIES INC	PA
FRASER PAPER (NORANDA FINANCE)	
FROST PAINT & OIL	MN
FULCRUM III LTD PARTNERSHIP	NY
WOODSTUFF	
FUNK FINECAST INC	OH
G L INDUSTRIES OF INDIANA	IN
COMO PLASTICS	
G T PRODUCTS INC	MI
G W LISK CO	NY
GAF CORP	NJ
GARDEN STATE TANNING	
(HM ANGLO-AMERICAN)	
GARDEN WAY INC	NY
GATES CORP	CO
GAYSTON CORP	OH
GEFINOR (USA)	NY
SHAEFFER	
GENA LABORATORIES INC	TX
GENCORP INC	OH
GENERAL DYNAMICS CORP	MO
GENERAL ELECTRIC CO	CT
GENERAL FILTERS INC	MI
GENERAL METALS POWDER CO	OH
GENERAL MOTORS CORP	MI
GENEVA STEEL	UT
GENTEX CORP	PA
GEORGIA GULF CORP	GA

APPENDIX A—Companies Making Commitments to the 33/50 Program (February, 1992)

COMPANY	STATE
GEORGIA-PACIFIC CORP	GA
GETTERS CORP OF AMERICA	OH
GILBERT ENGINEERING (MERRILL LYNCH & CO)	
GILLETTE CO	MA
GIVAUDAN CORP	NJ
GLASGO PLASTICS INC	OH
GLEN RAVEN MILLS INC	NC
GLOBE MANUFACTURING CO	MA
GOODMAN MANUFACTURING CORP	TX
GOODYEAR TIRE & RUBBER CO	OH
GRAVURE PACKAGING INC	VA
GREAT WESTERN FOAM PRODUCTS	CA
GREEN BAY PACKAGING INC	WI
GREENVILLE TECHNOLOGY INC	OH
GRIFFITH POLYMERS	OR
GRUMMAN CORP	NY
GTI CORP	CA
GUARDSMAN PRODUCTS INC	MI
GUNDERSON (JAMES-FURMAN & CO)	
H & N CHEMICAL CO INC	NJ
H B IVES (HARROW INDUSTRIES)	
H C C INDUSTRIES	CA
HADCO CORP	NH
HALSTEAD INDUSTRIES INC	NC
HANDY & HARMAN	NY
HANDY BUTTON MACHINE CO	IL
HANLIN GROUP INC	NJ
HARBISON-FISCHER MANUFACTURING CO	TX
HARROW INDUSTRIES INC	MI
H B IVES	
HARVEY HOLDINGS	TX
HARVEY INDUSTRIES	
HARVEY INDUSTRIES (HARVEY HOLDINGS)	
HASTINGS MANUFACTURING CO	MI
HAUNI RICHMOND (KOERBER AG)	
HAWORTH INDUSTRIES INC	MI
HBD INDUSTRIES INC	OH
PEERLESS-WINSMITH	
HERCULES ENGINES INC	OH
HERCULES INC	DE
HERESITE PROTECTIVE COATINGS	WI
HEWLETT-PACKARD CO	CA
HI-SHEAR INDUSTRIES INC	NY
HILLSIDE CAPITAL INC	NY
CONGOLEUM	
HILLYARD ENTERPRISES INC	MO
HITCHINER MANUFACTURING CO	NH

COMPANY	STATE
HM ANGLO-AMERICAN LTD	NY
GARDEN STATE TANNING	
JADE CORP	
HOECHST CORP	NJ
HOFFMAN-LA ROCHE	NJ
HOMACO INC	IL
HOME INTERIORS & GIFTS	TX
DALLAS WOODCRAFT	
HONDA OF AMERICA	CA
HONEYWELL INC	MN
HONOLULU WOOD TREATING CO	HI
HOOVER SYSTEMS INC	TX
HOUSE OF PACKAGING INC	CA
HOWMET (PECHINEY)	
HPM CORP	OH
HUTCHENS INDUSTRIES INC	MO
HYDRO ALUMINUM USA INC	FL
HYDROZO (P C R GROUP)	
I R INTERNATIONAL (F C HOLDINGS)	
IBM	NY
ICI AMERICAN HOLDINGS	DE
ICI AMERICAN HOLDINGS	
VYTECH	
IDEAL STENCIL MACHINE & TAPE CO	IL
ILLINOIS TOOL WORKS INC	IL
IMC FERTILIZER GROUP INC	IL
IMCERA GROUP INC	IL
MALLINCKRODT	
IMPHY ALLOYS INC	NJ
TECHALLOY	
INA BEARING CO	SC
INCO UNITED STATES INC	NY
INDAL ALUMINUM (INDAL INC)	
INDAL INC	MS
INDAL ALUMINUM	
INDIANHEAD PLATING INC	WI
INDUSTRIAL HARD CHROME LTD	IL
INGERSOLL-RAND CO	NJ
INLAND STEEL INDUSTRIES INC	IL
INTEL CORP	CA
INTERLAKE CORP	IL
INTERNATIONAL PAPER CO	NY
IRVING TANNING (VISTA RESOURCES)	
ITEN INDUSTRIES INC	OH
ITT CORP	NY
ITT HIGBIE MANUFACTURING	
ITT HIGBIE MANUFACTURING (ITT CORP)	
J I CASE (TENNECO)	

COMPANY	STATE
J T SLOCOMB CO	CT
J&L SPECIALTY PRODUCTS	
(SPECIALTY MATERIALS)	
JACOBSON MANUFACTURING CO	NJ
PENN JACOBSON CO	
JADE CORP (HM ANGLO-AMERICAN)	
JAMES RIVER CORP OF VIRGINIA	VA
JAMES-FURMAN & CO	OR
GUNDERSON	
JAMESTOWN PAINT & VARNISH CO	PA
JEFFERSON SMURFIT (SIBV/MS HOLDINGS)	
JMK INTERNATIONAL INC	TX
JOHNSON & JOHNSON	NJ
JOHNSON CONTROLS INC	WI
JONES & VINING INC	MA
JORDAN GROUP	NY
AMERICAN SAFETY RAZOR	
JOYCE INTERNATIONAL INC	NY
STREATER	
JULIAN LUMBER CO	OK
K SYSTEMS	CA
KAISER ELECTROPRESCISION	
KAISER ELECTROPRESCISION (K SYSTEMS)	
KALAMA CHEMICAL	WA
KALCOR COATINGS COMPANY INC	OH
KANTHAL CORP	CT
KASPAR WIRE WORKS INC	TX
KELSO ASI PARTNERS L P	NY
AMERICAN STANDARD	
KENNECOTT (RTZ AMERICA INC)	
KENNEDY MANUFACTURING CO	OH
KERN-LIEBERS USA INC	OH
KERR-MCGEE CORP	OK
KEY PLASTICS INC	MI
DEL-CRAFT	
KEY TRONIC CORP	WA
KEYSTONE STEEL & WIRE (CONTRAN)	
KEYWELL CORP	MD
KIMBERLY-CLARK CORP	TX
KITZINGER COOPERAGE CORP	WI
KLIPSCH & ASSOCIATES INC	IN
KNOWLES ELECTRONICS	IL
KOCH LABEL COMPANY INC	IN
KOEHLER MANUFACTURING CO	MA
KOERBER AG	VA
HAUNI RICHMOND	

COMPANY	STATE
KOLENE CORP	MI
KRAFT GENERAL FOODS (PHILIP MORRIS)	
LANGLEY CORP (FLEET AEROSPACE)	
LECO CORP	MI
LECTROMAT INC	PA
LEHIGH PRESS INC	NJ
LENMAR CHEMICAL CORP	GA
LIEBEL FLARSHEIM CO	OH
LINCOLN ELECTRIC CO	OH
LINCOLN GROUP INC	SC
LOCKHEED CORP	CA
LOMAC	MI
LORIN INDUSTRIES INC	MI
LOUISIANA-PACIFIC CORP	OR
LOUISVILLE TILE DISTRIBUTORS	KY
CAMEO MARBLE	
LTV AEROSPACE (LTV CORP)	
LTV CORP	TX
LTV AEROSPACE	
LTV STEEL	
LTV STEEL (LTV CORP)	
LUBRIZOL CORP	OH
LUKE ENGINEERING & MANUFACTURING	OH
LUSTRE-CAL NAMEPLATE CORP	CA
LYONDELL PETROCHEMICAL CO	TX
M H GRAHAM	MS
MACLEAN-FOGG CO	IL
MACANDREWS FORBES HOLDINGS	NY
COLEMAN OUTDOOR PRODUCTS	
MACDONALD CARBIDE CO	CA
MADIX INC	TX
MAGEE INDUSTRIAL ENTERPRISES	PA
MALLINCKRODT (IMCERA GROUP)	
MANNER PLASTIC MATERIALS	CA
MANNING FABRICS INC	NC
MANSFIELD PAINT CO	OH
MANVILLE CORP	CO
MARATHON ELECTRIC MANUFACTURING	WI
MARION MERRELL DOW (DOW CHEMICAL)	
MARKEM CORP	NH
MARTIN MARIETTA CORP	MD
MARVIN LUMBER & CEDAR CO	MN
MARVIN WINDOWS	
MARVIN WINDOWS (MARVIN LUMBER & CEDAR)	
MASCO INDUSTRIES INC	MI
MASK-OFF CO	CA
MASON AND HANGER (MASON CO)	

COMPANY	STATE
MASON CO	KY
MASON AND HANGER	
MASTERMOLD	WI
MAUTZ PAINT CO	WI
MAYO CHEMICAL CO	GA
FARM & INDUSTRIAL CHEMICAL	
MCCULLOUGH (SHOP VAC CORP)	
MCDONNELL DOUGLAS CORP	MO
MEAD CORP	OH
MEADEN SCREW PRODUCTS CO	IL
MECHANICAL GALV-PLATING CORP	OH
MECO INC	IL
MEMOREX CORP	CA
MERCER INDUSTRIES	OR
MERCK & CO INC	NJ
MERRILL LYNCH & CO	NY
GILBERT ENGINEERING	
METAL-COTE INC	MI
METALLICS INC	WI
METROMEDIA CO	NJ
METROMEDIA TECHNOLOGIES	
METROMEDIA TECHNOLOGIES	
(METROMEDIA CO)	
MICOM CORP	MN
MID AMERICA CLUTCH	IN
MID-WEST INDUSTRIAL CHEMICAL CO	MO
MIDDCO TOOL & EQUIPMENT INC	WA
MIDDLESEX RESEARCH MANUFACTURING	MA
MILLIKEN & COMPANY	SC
MILLIPORE CORP	MA
MOBIL CORP	VA
MODERN METAL PRODUCTS CO	IL
MODINE MANUFACTURING CO	WI
MOLDED FIBER GLASS CO	OH
MON-ECO INDUSTRIES INC	NJ
MONARCH LITHO INC	CA
MONROE EQUIPMENT (TENNECO)	
MONSANTO CO	MO
MOORE BUSINESS FORMS	IL
MORGAN STANLEY LEV EQ FUND II	NY
ESSEX	
MOTOROLA INC	IL
NABORS MANUFACTURING	TN
NALGE CO (SYBRON ACQUISITION)	
NASHUA CORP	NH
NATIONAL BANNER CO	TX
NATIONAL CHROMIUM CO	CT
NATIONAL COOPER & SMELTING	
(NATIONAL TUBE HOLDING)	
NATIONAL ELECTRICAL CARBON	SC
NATIONAL MANUFACTURING CO	IL
NATIONAL METALS INC	AL
NATIONAL TUBE HOLDING CO	AL
NATIONAL COOPER & SMELTING	
NAUGATUCK GLASS CO	CT
NELSON INDUSTRIES INC	WI
NEO-WOOD PRODUCTS CO	OH
NEW DIMENSION PLATING	MN
NEWELL CO	IL
NEWPORT ADHESIVES & COMPOSITES	CA
NORANDA FINANCE INC	TN
FRASER PAPER	
NORDSON CORP	OH
NORTH AMERICAN PAINT CORP	NJ
NORTHERN PRECISION CASTING CO	WI
NORTHROP CORP	CA
NUPLA CORP	CA
NUTONE INC	OH
O'SULLIVAN CORP	VA
OAK PARTNERS INC	IL
BARNETT VARNISH	
OCCIDENTAL PETROLEUM CORP	CA
OHIO ART CO	OH
OHLINE CORP	CA
OLIN CORP	CT
OPTICAL COATING LABORATORY	CA
ORCON CORPORATION	CA
OREGON STEEL MILLS INC	OR
OWENS-CORNING FIBERGLAS CORP	OH
P B & H MOLDING CORP	NY
P C R GROUP INC	FL
HYDROZO	
PACIFIC ALLOY CASTINGS	CA
PACKAGING CORP (TENNECO)	
PANEL PROCESSING INC	MI
PARKER HANNIFIN CORP	OH
PARKER PEN USA LTD	WI
PARSONS & WHITTEMORE ENTERPRISES	NY
ALABAMA RIVER PULP	
PAULSEN WIRE ROPE CORP	PA
PECHINEY CORP	CT
HOWMET	
PEERLESS OF AMERICA INC	IL
PEERLESS-WINSMITH (HBD INDUSTRIES)	

COMPANY	STATE
PENN COLUMBIA CORP	NY
BLOOMSBURG MILLS	
PENN JACOBSON (JACOBSON MFG)	
PENNZOIL CO	TX
PERRIGO CO	MI
PERRY & DERRICK CO	OH
PETRO CHEMICAL PRODUCTS INC	FL
PETROLITE CORP	MO
PFISTER CHEMICAL INC	NJ
PFIZER INC	NY
PHILIP MORRIS CO	NY
KRAFT GENERAL FOODS	
PHILLIPS PETROLEUM CO	OK
PHILLIPS PLASTICS CORP	WI
PHOENIX HEAT TREATING INC	AZ
PHOTOCIRCUITS CORP	NY
PINES TRAILER LTD PARTNERSHIP	IL
PITNEY BOWES INC	CT
PLUMMER PRECISION OPTICS	PA
PLYMOUTH RUBBER COMPANY INC	MA
PMF INDUSTRIES INC	PA
POLAROID CORP	MA
POLY PAK INDUSTRIES INC	NY
POM INC	AR
POTLATCH CORP	CA
POWELL INDUSTRIES INC	TX
PPG INDUSTRIES INC	PA
PQ CORP	PA
PRECISION CASTPARTS CORP	OR
PRECISION FABRICS GROUP INC	NC
PRECISION PLATING CO	IL
PRECISION PRODUCTS INC	IL
PREMARK INTERNATIONAL INC	IL
PRINTED CIRCUIT CORP	MA
PROCTER & GAMBLE CO	OH
PROGRESS CASTING GROUP INC	MN
PROSPECT INDUSTRIES (PROSPECT PURCHASING)	
PROSPECT PURCHASING CO	NJ
PROSPECT INDUSTRIES	
PROVIDENCE METALLIZING CO	RI
PRUETT-SCHAFFER CHEMICAL CO	PA
QUAKER STATE CORP	PA
QUALITY COATINGS INC	IN
QUALITY METAL PRODUCTS INC	CO
QUALITY ROLLING & DEBURRING CO	CT
QUANTUM CHEMICAL CORP	NY
R G F ENTERPRISES INC	CA

COMPANY	STATE
R H SHEPPARD COMPANY INC	PA
R L C INDUSTRIES CO	OR
ROSEBURG LUMBER	
R P ADAMS CO	NY
RAMPART INDUSTRIES INC	MI
RANBAR TECHNOLOGY INC	PA
RAYOVAC CORP	WI
RAYTHEON CO	MA
RED SPOT PAINT & VARNISH CO	IN
REFRACTORY SALES & SERVICE CO	AL
REINHOLD (BAIRNCO CORP)	
REINZ WISCONSIN GASKET CO	WI
RELIANCE FINISHING CO	MI
REPUBLIC ENGINEERED STEELS	OH
REPUBLIC STORAGE SYSTEMS CO	OH
RESILITE SPORTS PRODUCTS INC	PA
REVCOR INC	IL
REVLIS CORP	OH
REYNOLDS METALS CO	VA
RHONE-POULENC INC	NJ
RICO COATINGS INC	GA
RIDG-U-RACK (DITRI ASSOCIATES)	
RIVER CAPITAL PARTNERS I	GA
DECOR GRAVURE	
RIVERSIDE HOLDINGS INC	AR
RIVERSIDE INTERNATIONAL INC	MI
RJR NABISCO HOLDINGS	NY
ARCHER CO	
ROBERT WEED PLYWOOD CORP	IN
ROBINSON RUBBER PRODUCTS	MN
ROCKWELL INTERNATIONAL CORP	CA
ROHM AND HAAS CO	PA
ROLSCREEN CO	IA
ROMAC ELECTRONICS INC	NY
ROME CABLE (ROME GROUP INC)	
ROME GROUP INC	NY
ROME CABLE	
ROMO INC	WI
RONKEN INDUSTRIES INC	IL
ROSEBURG LUMBER (R L C INDUSTRIES)	
RSR HOLDING CORP	TX
RTZ AMERICA INC	UT
KENNECOTT	
RUBICON INC	LA
RUDDICK CORP	NC
AMERICAN & EFIRD	
RUSSELL CORP	AL
S C JOHNSON & SON INC	WI

APPENDIX A—Companies Making Commitments to the 33/50 Program (February, 1992)

COMPANY	STATE
SADOLIN PAINT PRODUCTS INC	NC
SANDEN OF AMERICA INC	CA
SANDOZ CORP	NY
SANDSTROM PRODUCTS CO	IL
SARA LEE CORP	IL
SARGENT-FLETCHER (A J INDUSTRIES)	
SARTORIUS NORTH AMERICA INC	NY
SAUNDERS SUPPLY CO	VA
SCHERING-PLOUGH CORP	NJ
SCHNELLER INC	OH
SCOTT PAPER CO	PA
SEABOARD METAL FINISHING CO	CT
SEAWARD INTERNATIONAL	VA
SEM PAINT CO	CA
SENECA FOODS CORP	NY
SHAEFFER (GEFINOR)	
SHELL PETROLEUM INC	DE
SHELLER-GLOBE (UNITED TECHNOLOGIES)	
SHEPHERD CHEMICAL	OH
SHERWIN-WILLIAMS CO	OH
SHOP VAC CORP	PA
MCCULLOUGH	
SHUFORD INDUSTRIES INC	NC
SIBV/MS HOLDINGS INC	MO
JEFFERSON SMURFIT	
SIEBE INC	MA
FOXBORO	
SILVER FURNITURE CO	TN
SIMPSON INVESTMENT CO	WA
SIMPSON PAPER	
SIMPSON PAPER (SIMPSON INVESTMENT)	
SKF USA INC	PA
SLATER STEELS	IN
SMITH EVERETT INV LTD	WI
EAGLE OTTAWA LEATHER	
SMITH SYSTEM MANUFACTURING CO	MN
SMITHKLINE BEECHAM AMERICAS	PA
SNYDER GENERAL CORP	TX
SOMMER METALCRAFT	IN
SONOCO PRODUCTS CO	SC
SOUTHWIRE (SPECTRUM LTD)	
SPD TECHNOLOGIES INC	PA
SPECIALTY MATERIALS CORP	PA
J&L SPECIALTY PRODUCTS	
SPECTRULITE CONSORTIUM INC	IL
SPECTRUM LTD	GA
SOUTHWIRE	
SPIROL INTERNATIONAL HOLDING CO	CT

COMPANY	STATE
SPRAY PRODUCTS CORP	PA
SPRAYING SYSTEMS CO	IL
STANDARD CHLORINE CHEMICAL CO	NJ
STANDARD INDUSTRIES INC	TX
STANDARD MOTOR PRODUCTS INC	NY
STAR ENTERPRISE	TX
STEEL OF WEST VIRGINIA INC	WV
STEELCASE INC	MI
STEPHENSON & LAWYER INC	MI
STERLING CHEMICALS INC	TX
STEWART HALL CHEMICAL CORP	NY
STILLWATER INVESTMENT	CT
UNITED ELECTRIC	
STOLPER INDUSTRIES INC	WI
FABRALLOY	
STORA HOLDING INC	NJ
TARKETT	
STOREYS TRANSPRINT INC	VA
STREATER (JOYCE INTERNATIONAL)	
SUBA MANUFACTURING INC	CA
SUMITOMO METAL USA CORP	NY
WESTERN TUBE & CONDUIT	
SUMMITVILLE TILES INC	OH
SUN COMPANY INC	PA
SUN METAL PRODUCTS INC	IN
SUNNEN PRODUCTS	MO
SUNSET FIREPLACE FIXTURES	CA
SWANK INC	MA
SYBRON ACQUISITION CO	WI
NALGE CO	
SYBRON CHEMICALS (CITICORP)	
SYNTEX AGRIBUSINESS (SYNTEX USA)	
SYNTEX USA INC	CA
SYNTEX AGRIBUSINESS	
TALON INC	PA
TARKETT (STORA HOLDING)	
TAWAS PLATING CO	MI
TECH INDUSTRIES INC	RI
TECHALLOY (IMPHY ALLOYS)	
TECHMETALS INC	OH
TECUMSEH PRODUCTS CO	MI
TEKNI-PLEX INC	NY
TELLABS INC	IL
TEMPLE-INLAND INC	TX
TEMPRESS INC	WA

COMPANY	STATE
TENNECO INC	TX
J I CASE	
MONROE EQUIPMENT	
PACKAGING CORP	
TEXACO INC	NY
TEXAS INDUSTRIES INC	TX
CHAPARRAL STEEL	
TEXAS INSTRUMENTS INC	TX
THIOKOL CORP	UT
THOMAS INDUSTRIES INC	KY
THOMAS STEEL STRIP CORP	OH
THOMSON CONSUMER ELECTRONICS	IN
TIMKEN CO	OH
TISHCON CORP	NY
TOLEDO COKE CORP	OH
TORWICO ELECTRONICS INC	NJ
TOWER OIL & TECHNOLOGY CO	IL
TRANSCO PRODUCTS CORP	NJ
TRI-STATE POLE & PILING INC	MS
TRINOVA CORP	OH
TRIPLEX PLATING INC	IN
TUSONIX INC	AZ
U S ENTERPRISE	IL
WASHINGTON STEEL	
U S STEEL (U S X CORP)	
U S X CORP	PA
U S STEEL	
U T I CORP	PA
UNIFORM TUBES	
UCC INVESTORS HOLDING	CT
UNIROYAL CHEMICAL CO	
ULTRA FORGE INC	OH
UNIFORM TUBES (U T I CORP)	
UNION CAMP CORP	NJ
UNION CARBIDE CORP	CT
UNION ZINC INC	TN
UNIROYAL CHEMICAL	
(UCC INVESTORS HOLDING)	
UNITED AGRI PRODUCTS (CONAGRA)	
UNITED ELECTRIC (STILLWATER INVESTMENT)	
UNITED SILK MILLS INC	NY
BURRELL-LEDER BELTECH INC	
UNITED TECHNOLOGIES	CT
UNITED TECHNOLOGIES	
SHELLER-GLOBE	
UNIVERSAL COOPERATIVES INC	MN
UNIVERSAL PACKAGING CORP	NH
UNOCAL CORP	CA

COMPANY	STATE
UOP	IL
UPJOHN CO	MI
USS-POSCO INDUSTRIES	CA
VAIL RUBBER WORKS	MI
VALLEY CRAFT	MN
VALSPAR CORP	MN
VAN DER HORST USA CORP	TX
VANGUARD PAINTS & FINISHES	OH
VARIAN ASSOCIATES INC	CA
VELIE CIRCUITS INC	CA
VELSICOL CHEMICAL CORP	IL
VICOM INC	TX
VISKASE (EMERALD ACQUISITION)	
VISTA CHEMICAL CO	TX
VISTA RESOURCES INC	NY
IRVING TANNING	
VIZ MANUFACTURING CO	PA
VULCAN MATERIALS CO	AL
VYTECH (ICI AMERICAN HOLDINGS)	
W J RUSCOE CO	OH
W M BARR & CO	TN
W R GRACE & CO	NY
W W CUSTOM CLAD INC	NY
WABASH NATIONAL CORP	IN
WALLE CORP	LA
WALTCO ENGINEERING CO	CA
WARLICK PAINT CO	NC
WARN INDUSTRIES (WARNCOM)	
WARNCOM INC	OR
WARN INDUSTRIES	
WARNER-LAMBERT CO	NJ
WASHINGTON STEEL (U S ENTERPRISE)	
WEIRTON STEEL CORP	WV
WEISS-AUG CO	NJ
WELDON TOOL CO	OH
WELLCO ENTERPRISES INC	NC
WELLONS	OR
WESTERN RESERVE MANUFACTURING CO	OH
WESTERN TUBE & CONDUIT	
(SUMITOMO METAL)	
WESTINGHOUSE ELECTRIC CORP	PA
WESTVACO CORP	NY
WEYERHAEUSER CO	WA
WHIRLPOOL CORP	MI
WHITE CONSOLIDATED INDUSTRIES	OH
WHITEHALL CORP	TX
WHITTAR STEEL STRIP (DOFASCO)	
WILKO PAINT	KS

APPENDIX A—Companies Making Commitments to the 33/50 Program (February, 1992)

COMPANY	STATE
WILLAMETTE INDUSTRIES INC	OR
WINCO INC	MN
WINONA CORP	IN
WISCONSIN TOOL & STAMPING CO	IL
WISE CO	AR
WITCO CORP	NY
WOLVERINE HOLDING CO	AL
WOLVERINE TUBE	
WOLVERINE TUBE (WOLVERINE HOLDING)	
WOOD PRESERVERS INC	VA
WOODBRIDGE HOLDINGS INC	PA
WOODSTUFF (FULCRUM III LTD PARTNERSHIP)	
WORLD GENERATOR CO	IL
WORTH INC	TN
XEROX CORP	CT
YALE SECURITY INC	NC
YOUNGWOOD ELECTRONIC METALS	PA
ZIMMERMAN HOLDINGS INC	CA
F W WINTER	
FLEXONICS	
ZIRCOA INC	OH

ONTARIO'S WATER PROGRAM - AN OVERVIEW

by
Jim Ashman, Director, Water Resources
Branch, Environment Ontario, Toronto

At the time of assembly of the Proceedings for printing, a text of the author's paper had not been submitted for inclusion in the numerical sequence.

If the paper was subsequently received, it is incorporated in these Proceedings following the listing of the Conference delegates.

Otherwise, those wishing further details on this subject, are asked to contact the author direct.

9/22/92

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Burlington, Ontario

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Atlantic Packaging Ltd.,
Scarborough, Ontario

Tom Murphy, Research
Scientist, Lakes Research Branch,
National Water Research Institute,
Burlington, Ontario

Richard Cave, Managing Partner
R. Cave and Associates Ltd.,
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Dennis D. Lang, Director of Engineering,
The Toronto Harbour Commissioners,
Toronto, Ontario

The ZenoGem™ Process for Industrial Wastewater Treatment

by

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General Motors Corporation, Detroit, Mich.

1.1 Background

There are numerous industrial wastewater treatment technologies available on the market each with inherent advantages over competing technologies. Some of these technologies have been commercially exploited for many years while others have only recently become cost-effective as a result of integrating advances in related disciplines, e.g. process control, into existing processes. To properly select the most cost-effective wastewater treatment technology for a particular application, the technical advantages have to be understood and an evaluation has to be made to determine if those advantages justify using the technology.

The ZenoGem™ process is an example of a process that has evolved through the integration of recent advances in ultrafiltration (UF) technology with biological treatment. It is from the UF technology that the ZenoGem™ process derives its inherent advantages and with recent developments in UF membrane construction, the cost-effectiveness of the process has been established.

The ZenoGem™ process was originally developed by Zenon in conjunction with General Motors Corporation.

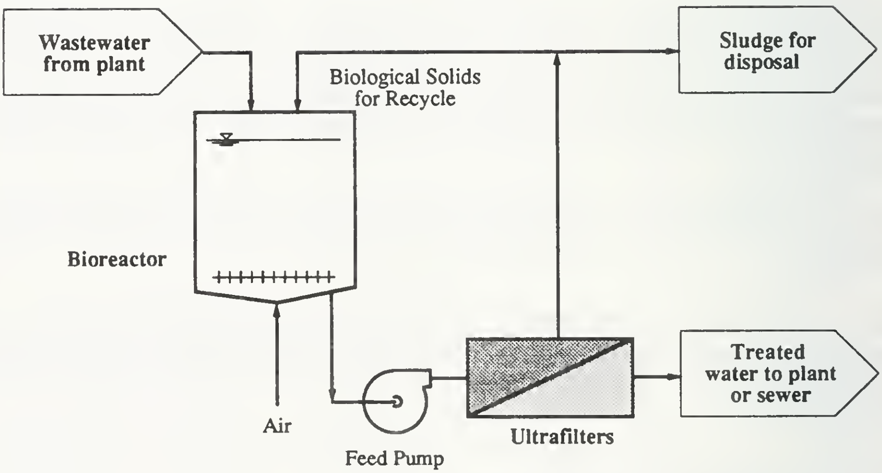
This paper describes the specific inherent advantages of the ZenoGem™ process and how these advantages have been demonstrated in the results of pilot studies conducted on three industrial effluent streams.

1.2 The ZenoGem™ Process

ZenoGem™ is a proprietary Zenon process (patents pending) that consists of a suspended growth activated sludge system (biological reactor) integrated with an ultrafiltration membrane system (Figure 1). The ultrafilter not only filters the treated water prior to discharge and recycles the biological solids to the bioreactor, but also recovers the higher molecular weight soluble materials that would otherwise pass through conventional clarifiers and filters. These higher molecular weight materials are returned to the bioreactor for further biodegradation prior to ultimate discharge.

Figure 1

ZenoGem™ Flow Schematic



Ultrafiltration (UF) is a pressure-driven cross flow filtration process in which the water to be processed flows tangentially over the surface of a membrane filter capable of separating both insoluble materials (bacteria, colloids, suspended solids) and higher molecular weight soluble materials from the treated water. The filtrate and the retentate are commonly referred to as permeate and concentrate respectively (Figure 2). The threshold size above which organics are retained by the membrane and below which they pass through the membrane is called the molecular weight cut-off. This ranges between 3,000 and 100,000 Daltons (0.003μ to 0.1μ) and is dependent upon the specific membrane chemistry. The UF spectrum is compared with other cross flow filtration processes (reverse osmosis, microfiltration) in Figure 3.

In the ZenoGem™ process, the concentrate is recycled to the bioreactor while the permeate is either discharged to the sewer or reused within the plant. The typical operating pressure of a UF system is 60 - 70 psi.

1.3 The Advantages of the ZenoGem™ Process

The three inherent advantages of a UF system are:

a) Virtually absolute removal of suspended solids and biomass; bacteria and other suspended solids are too large to pass through the molecular pores in the membrane.
b) Rejection of emulsified oils and large molecular weight soluble materials.
c) The ability of the UF to reject these materials is totally independent of raw waste composition, bioreactor conditions, biomass settleability and UF operating conditions.

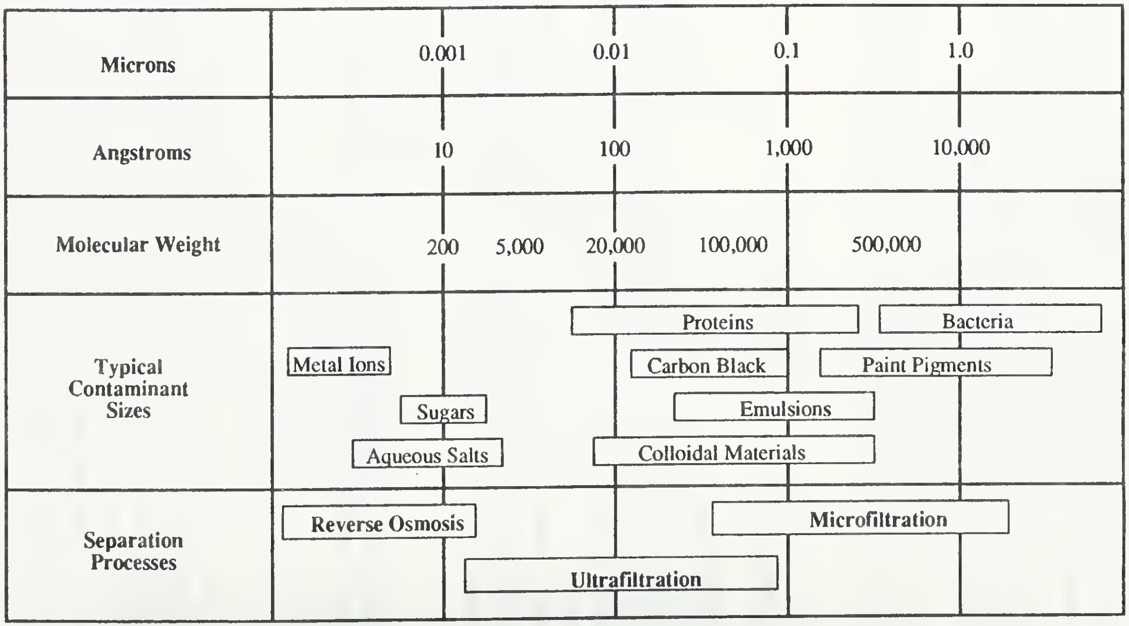
These inherent advantages of an ultrafilter translate into the following advantages for the ZenoGem™ process in specific applications:

i) Process is Not Vulnerable to Upsets

The most common problem encountered in conventional biological systems is the loss of biological solids because of process upsets or changes in the hydraulic or organic loading. In a conventional activated sludge system, clarifier performance depends on the settleability of the floc. If an upset occurs and a difficult-to-settle "pin floc" or "filamentous floc" forms, the biological solids can easily be lost. In the short term, an effluent high in suspended solids and BOD_5 will be produced. The effluent BOD_5 will remain high until the biological population has been restored. If an upset occurs in a fixed film type biological system (e.g. rotating biological contactor, fluidized bed) and sloughing occurs, these solids can be lost from the system resulting in poor quality effluent.

Figure 3

Filtration Spectrum



In the ZenoGem™ process, the effluent quality is not dependent upon settleability of the biological floc. The biological solids will be retained even if an upset occurs in the bioreactor. The UF membranes are very robust and experience has proven that the risk of failure resulting in the loss of biological solids is very remote.

ii) Improved Effluent Quality

The ultrafiltration membrane provides virtually absolute suspended solid-liquid separation thus preventing the discharge of biological or other suspended solids in the effluent. Furthermore, certain soluble organics and both free and emulsified oil & grease are retained, thereby further improving the effluent quality.

iii) Reduced Sludge Production

In contrast with physical-chemical waste treatment processes, the volume of sludge produced is significantly reduced since chemicals are not required for precipitation / coagulation reactions. In contrast with other biological processes, the ZenoGem™ process will generally operate at longer solids retention times (i.e. 50 - 100 days) and thereby generate less sludge.

iv) Improved Biological Degradation of Retained Organics

In all other competing technologies including activated sludge, sequencing batch reactors, rotating biological contactors, fluidized bed and trickling filters, an emulsified oil molecule or other large molecular weight pollutant entering the system remains in the bioreactor for the same time as a drop of water entering the system. The retention time for that molecule in the system is the hydraulic retention time (HRT)(Table 1). In the ZenoGem™ process, the UF returns the molecule to the bioreactor and the only departure routes are via biodegradation or if wasted with the sludge. The retention time for the molecule is now the solids retention time (SRT). In terms of actual time, instead of only providing a retention time on the order of hours or days for the bacteria to degrade the waste, the UF retains these pollutants for a time on the order of weeks or months. The biological population has a longer time to mineralize the organics and better degradation is achieved. This ability to separate soluble pollutants, in particular emulsified oil & grease, from the treated water is not found in any other biological treatment process.

Figure 2

Cross Flow Filtration

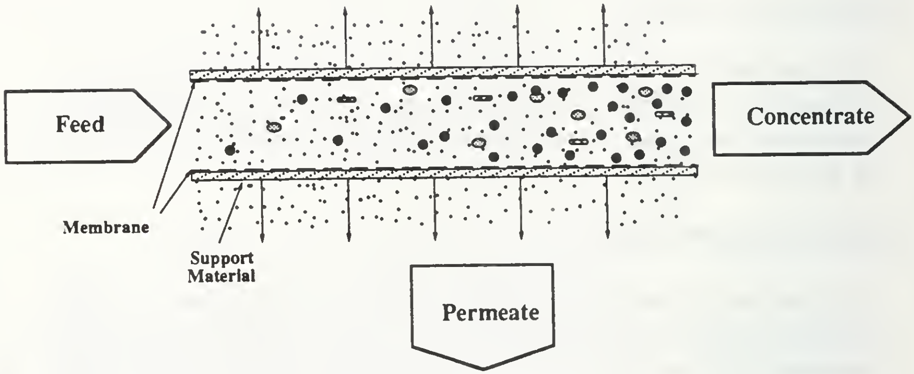


Table 1

Retention Times for Water and Soluble Pollutants in Biological Processes

Process	Water	Soluble Pollutants
Activated Sludge	HRT	HRT
Sequencing Batch Reactor (SBR)	HRT	HRT
Rotating Biological Contactor (RBC)	HRT	HRT
Fluidized Bed	HRT	HRT
Trickling Filter	HRT	HRT
ZenoGem™	HRT	**SRT**

HRT range: 3 hours - 4 days
SRT range: 5 - 75 days

The term "soluble pollutants" refers to those materials that are in solution and rejected by a UF membrane and includes emulisified oils and large molecular weight compounds.

v) Nitrification Can be Achieved without Requiring a Second Bioreactor.

Because virtually no solids are lost via the permeate (discharge) stream and because the wasting of biological solids (including nitrifying bacteria) is strictly controlled, the sludge age can be accurately controlled and nitrification can been achieved in a single bioreactor system.

vi) Improved Oxygen Transfer Efficiency Reduces Aeration Requirements

Oxygen transfer in ZenoGem™ systems is improved over competitive systems because the biological cells in the bioreactor are more dispersed and oxygen diffuses more rapidly to all the cells. In competitive systems, oxygen transfer to the cells at or near the centre of a floc or near the surface of a fixed film system is restricted by the cells in the immediate vicinity. With improved oxygen transfer efficiency, less aeration is required and the operating costs may be reduced.

The inherent strengths of the ZenoGem™ process have become more and more significant in recent years as improved membrane chemistries and configurations have provided the process with the necessary economic advantage to develop in the marketplace. The ZenoGem™ process is ideally suited to applications in which:

- i) the wastewater contains significant quantities of emulsified oil & grease, or
- ii) the wastewater contains suspended solids that do not settle out easily, or
- iii) conventional treatment processes cannot produce an effluent that consistently meets the discharge requirements, or
- iv) sludge disposal costs are a significant contributor to the treatment cost, or
- v) an opportunity exists to reuse the treated water within the plant as make-up water, or
- vi) nitrification is required, or
- vii) retention of certain soluble components is critical to achieving treatment objectives.

2.0 PILOT TEST PROGRAM

2.1 Pilot Test Objective

The objective in all studies was to determine the performance of the system under in-plant conditions as measured by:

- effluent quality
- sludge production
- operational considerations

The experimental data were translated into preliminary full scale design data from which capital and operating costs were estimated. Ultimately, the cost-effectiveness of the various full scale systems was calculated by the clients.

2.2 Pilot Test Descriptions

Descriptions of the sites and the wastewaters are presented in Table 2. The tests were conducted over periods ranging from 4 months to 12 months. During the various tests, ZenoGem™ performance was evaluated under hydraulic retention times (HRT) of 0.9 - 3.7 days and solids retention times (SRT) of 35 to 100 days.

The pilot equipment in all studies consisted of an equalization tank, feed pump, bioreactor with air spargers, pH control system, level controls and a UF system (Figure 4). The bioreactor working volume was 50 gallons for the industrial liquid transfer site and 700 gallons at the automotive facilities. The UF system consisted of a process pump, pressure, flow and temperature indicators, programmable logic controller and either 1, 2 or 3 "Z8" UF modules manufactured by ZENON. Two membrane chemistries designated "HSC" and "TAM" were used during testing and the performance was compared. If the wastewater was deemed deficient in either nitrogen or phosphorous, these elements were added to the bioreactor on a continuous basis via a separate metering pump.

In all tests, after bioreactor seeding and ultrafilter commissioning by ZENON staff, the pilot equipment was operated by the clients' staff with technical support provided by ZENON through follow-up site visits and via the telephone.

The analytical tests were the clients' responsibility and were conducted either by the clients' staff or under subcontract by external private laboratories. All analytical procedures were based on Ontario Ministry of the Environment and/or United States EPA protocols. All oil & grease tests were conducted with freon as the solvent. Because BOD_5 tests are not accurate indicators of the extent to which acclimated organisms are able to degrade a waste and because of the long time required to obtain BOD_5 test results, COD was selected instead of BOD_5 as one of the primary parameters for routine performance monitoring purposes.

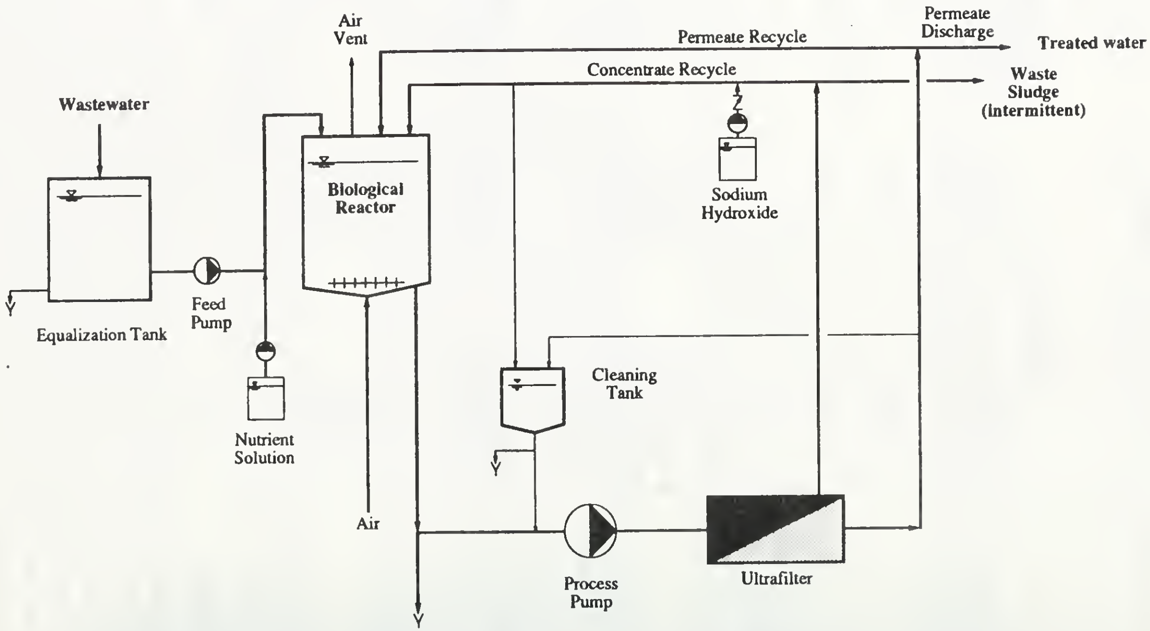
Table 2

Pilot Test Descriptions

Test	Oily Wastewater Site #1	Oily Wastewater Site #2	Industrial Liquid Waste Transfer Station
Location	Ohio	Ontario	Ontario
Facility	Automotive	Automotive	Industrial
Duration (months)	12	9	4
Wastewater description	≈50% synthetic & semi-synthetic metalworking fluids; remainder mineral oil based	>90% mineral oil based metal-working fluids	laundry sludge, food grease, phosphate wastes; paint & pigments
Primary pollutants	emulsified oils surfactants	emulsified oils surfactants	emulsified oils suspended solids
Key parameters	TFOG HFOG BOD	TFOG HFOG BOD	BOD TSS TFOG
Nutrient requirements	none	N,P	none

Figure 4

Pilot System Schematic



After seeding of the bioreactor with activated sludge, a startup period of approximately 4 weeks was allowed to establish the biological population. During this time, the HRT was gradually reduced until the desired HRT was attained. No biological solids were discharged during this startup period. During a subsequent 3 - 4 week acclimation phase, the HRT remained constant and biological solids wasting at a rate corresponding to the desired SRT was initiated. Analytical sampling during this acclimation phase generally consisted of weekly analyses of the primary analytical parameters (COD, total oil & grease, and hydrocarbon oil & grease). After acclimation, a 2 - 3 week equilibrium phase was defined during which analyses were conducted either two or three times per week for the primary parameters and weekly for the secondary parameters (BOD_5, cations, TKN, ammonia-N, phosphorous). Following the equilibrium phase, the bioreactor operating conditions were adjusted corresponding to a new HRT /SRT and the cycle of acclimation phase and equilibrium phase testing was repeated.

During the testing at the automotive sites, various wastewaters were processed by the system. At site #1, wastewater was transported by tanker from another facility for 3 months of testing. At site #2, the wastewater was supplemented with synthetic metalworking fluids for a portion of the test program.

Cleaning of the ultrafilter membranes was performed generally on a weekly or biweekly basis but sometimes up to 8 weeks elapsed between cleanings.

Table 7

Effluent Quality
Industrial Transfer Station

Parameter	Influent (ppm)	Effluent (ppm)	Reduction
BOD_5 (mg/L)	4280	<17	>99.6%
TFOG (mg/L)	2300	12	99.5%
TSS (mg/L)	3500	<10	>99.6%

3.0 EXPERIMENTAL RESULTS

3.1 Oily Wastewater Site #1

A summary of the effluent quality data is presented in Table 3. The results presented are simple arithmetic averages of all data collected during the various acclimation and equilibrium conditions. A total of 210 COD, 214 total fats, oils & grease (TFOG), and 154 hydrocarbon fats, oil & grease analyses of the feed and permeate were conducted during the course of the test program. An additional 45 samples of bioreactor contents were analysed for soluble COD, soluble TFOG and soluble HFOG. All other parameters were analysed between 28 and 59 times during the course of the testing.

The results indicate that an effluent of excellent quality was produced and that > 90% nitrification of TKN present in the raw wastewater was also achieved.

The performance of the ZenoGem™ system can be directly compared with the performance of the existing full-scale wastewater treatment system (Figure 5). The full scale system consisted of a physical/chemical system (chemical addition and dissolved air flotation) to break the emulsion and a fluidized bed biological system to reduce the BOD.

As discussed in Section 1.3, one of the primary advantages of the ZenoGem™ system is the ability of the UF system to retain soluble pollutants, in particular emulsified oil & grease, and to return these to the bioreactor for further biodegradation. The evidence to support this is presented in Table 4. The soluble COD, TFOG and HFOG were 3 - 11 times higher in the reactor (reactor contents filtered through 0.45μ filter paper and analysed) than in the effluent stream indicating that the UF was retaining soluble pollutants. There was concern that the oil & grease material was accumulating and not actually being "degraded" (mineralized, converted to biomass or otherwise rendered insoluble) and a mass balance was performed to determine the extent to which oil & grease were actually degraded versus the amount discharged in a soluble form with the sludge. This mass balance is presented in Table 5 and indicates that although the bioreactor soluble COD was high (almost as high as the feed), because so little sludge was discharged, the actual amount of COD that was not degraded was only 3.7%.

The amount of sludge generated by the ZenoGem™ was compared with that produced by the full-scale physical/chemical/fluid bed biological system and it was concluded, by the client, that the ZenoGem™ would produce less than 1/10 the amount of sludge compared with the existing system. The client also concluded that the ZenoGem™ system was simpler to operate and would require less direct labour. One reason was because the ZenoGem™ would be operated in a continuous mode whereas the existing system had to be operated in a batch mode with optimum chemical dosages determined through jar tests prior to processing individual batches of wastewater.

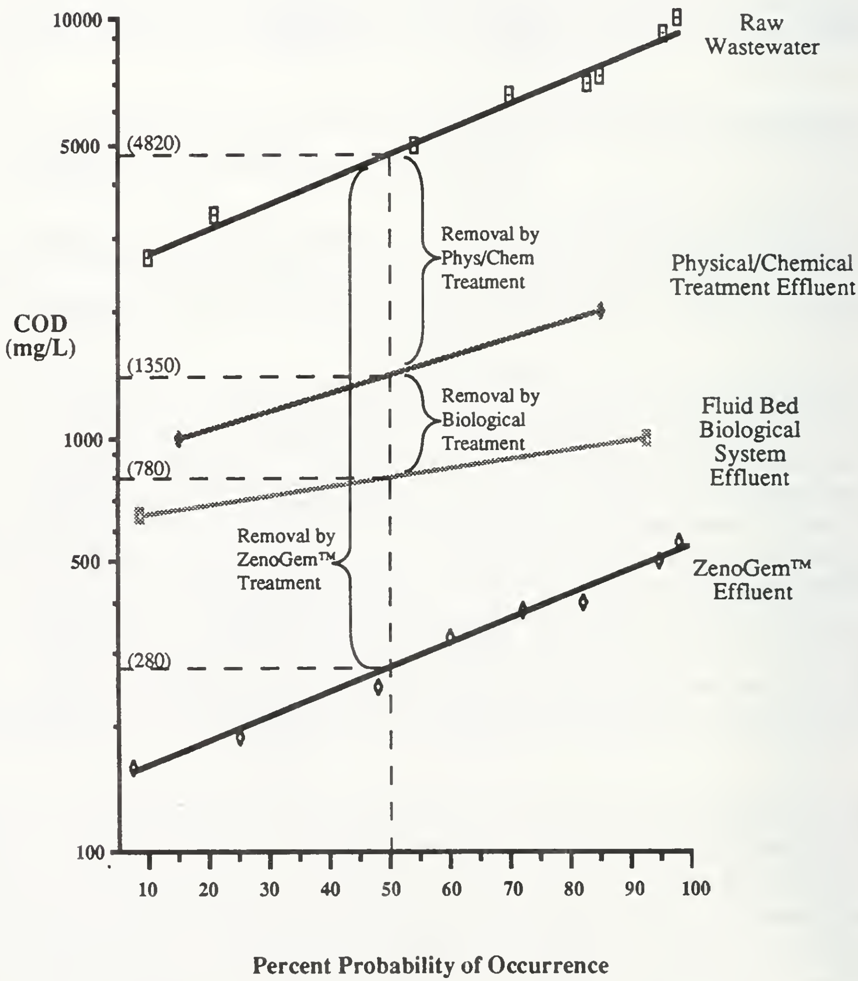
Table 3

Effluent Quality
Oily Wastewater - Site #1

Parameter	Influent (ppm)	Effluent (ppm)	Reduction
BOD_5	1170	17.3	98.5%
COD	5298	435	91.8%
TFOG	634	17.7	97.2%
HFOG	276	4.5	98.4%
TSS	--	<10	--
TKN	67	4.7	93.0%
NH_3-N	--	0.97	--
Lead	0.264	0.045	83.0%
Zinc	2.00	0.452	78.5%

Figure 5

Performance Comparison
ZenoGem™ vs. Physical/Chemical & Fluid Bed Biotreatment



Source: R.W. Hare et al, (1990)

Table 4

COD Results
Oily Wastewater - Site #1

Parameter	Feed (ppm)	Bioreactor Soluble (ppm)	Effluent (ppm)
COD	5298	4806	435
TFOG	634	69	17.7
HFOG	276	15	4.5

Table 5

Mass Balance
Oily Wastewater - Site #1

Parameter	Bio-oxidized (%)	Discharged as Permeate (%)	Discharged as Sludge (%)
COD	86.2	10.1	3.7
TFOG	96.7	3.0	0.3
HFOG	98.0	1.7	0.2

Note: Bio-oxidized refers to the material that was either converted into biomass or mineralized.

After a complete technical and ecònomic analysis by the client, it was concluded by R.W. Hare et al (1990) that:

> "The extent of the process information developed and the positive nature of the performance results observed, provide a high degree of assurance that a cost-effective full scale membrane bioreactor system can be designed and installed and can be expected to perform technically at a level equal to or better than a conventional oily wastewater treatment system."

On the basis of these results, a full scale system was designed and installed at one of the client's facilities. The full scale system was commissioned in September of 1991 and a formal performance evaluation is in progress. The results to date are very good and are consistent with the pilot scale results.

3.2 Oily Wastewater Site #2

The experimental data for this study are presented in Table 6 as arithmetic averages although there are proportionately fewer data points in comparison with site #1 because the testing was only 9 months in duration (160 analyses each for COD, TFOG and 124 HFOG analyses). The effluent quality is comparable with the results of the testing conducted at site #1.

At this site, because the wastewater consisted of primarily true mineral oil based metalworking fluids and very few synthetics or semi-synthetics, nitrogen was added in excess to ensure sufficient nitrogen would be available for biological growth. This is the reason that the TKN and ammonia-N levels were higher in the effluent than in the feed.

Of particular note is that the soluble COD in the bioreactor (1020 ppm) was only ≈ 2 x as high as the effluent COD whereas at site #1, the bioreactor soluble COD (4806 ppm) was ≈ 11 x higher than in the effluent. One logical explanation for this difference is that the synthetics and semi-synthetics at site # 1 were harder to degrade and required a longer retention time than the true mineral oil based metalworking fluids processed at site #2. This hypothesis is consistent with the inherent nature of synthetics and semi-synthetics. Because they are harder to degrade biologically, the solutions have a longer serviceable life and odour problems are reduced.

The client prepared a business case analysing the cost-effectiveness of the process on the basis of the experimental results. The analysis indicated that the process is cost-effective and preliminary plans for a full scale system are in preparation.

3.3 Industrial Transfer Station

The effluent quality data from this test are summarized in Table 7. Because the test was only of 4 months duration and testing was only conducted at two sets of equilibrium conditions, the data presented are arithmetic averages of 15 sampling times.

Greater than 99% removal was achieved for each of the three key performance parameters, BOD_5, TSS and total oil & grease. The effluent quality was excellent and easily met sewer discharge criteria. The client is considering a full scale ZenoGem™ system.

Table 6

Effluent Quality
Oily Wastewater - Site #2

Parameter	Influent (ppm)	Effluent (ppm)	Reduction
BOD_5	311	9.2	97.0%
COD	6450	540	91.6%
TFOG	2564	20.8	99.2%
HFOG	2205	1.7	>99.9%
TSS	615	< 3	>99.5%
TKN	4.45	23.1	--
NH_3-N	0.15	17.0	--
Al	2.71	0.034	98.7

4.0 SUMMARY AND CONCLUSIONS

The ZenoGem™ process integrates biological treatment with state-of-the-art ultrafiltration technology. The process derives its technical advantages from the inherent ability of a UF to reject suspended solids, bacteria, emulsified oils and large molecular weight soluble organics independent of the bioreactor operating conditions, wastewater quality, UF pressures or biomass settleability. Two of the key advantages are superior effluent quality (because of the absolute filtration achieved) and reduced vulnerability to upsets (because bacteria are not lost during upsets). Other advantages include reduced sludge production and the fact that simultaneous carbonaceous oxidation and nitrification can be achieved.

The experimental results of 3 on-site pilot studies totalling 25 months of testing indicate that an effluent of excellent quality can be achieved. The following removal efficiencies were achieved during these tests:

BOD_5	>97%
COD	92%
Total fats, oil & grease (TFOG)	>97%
Hydrocarbon fats, oil & grease (HFOG)	>98%

The effluent produced was virtually devoid of suspended solids and nitrification was achieved in the treatment of oily wastewater containing semi-synthetic and synthetic metalworking fluids. The analytical results also indicate that the UF retains a certain portion of the soluble COD, TFOG and HFOG thereby ensuring that these materials do not pass through the bioreactor without prior biodegradation.

The cost-effectiveness of the process depends on the specific application. If the inherent technical advantages offered by the ZenoGem™ process are required for successful treatment of a given wastewater, the ZenoGem™ process will be cost-effective. Conversely, if the advantages are of no significance, an alternative technology may be more cost-effective.

With specific reference to the treatment of oily wastewater from the automotive industry, a client prepared two separate detailed economic evaluations and concluded that the ZenoGem™ process was the most cost-effective alternative to a physical/chemical treatment system with and without biological posttreatment.

The ZenoGem™ process has tremendous potential in a wide variety of applications as environmental regulations tighten and as the costs associated with sludge disposal spiral upward.

5.0 ACKNOWLEDGEMENTS

The authors would like to thank Dr. Paul Sutton, Ph. D., (P.M. Sutton and Associates, Bethel, CT), and Mr. Phil Canning, Mr. John Bancsi, Mr. Ian Winter and Mr. Jeff Penny (Zenon Environmental Inc., Burlington, Ontario) for their contributions towards the success of the various on-site pilot studies.

6.0 REFERENCE

Hare, R.W., P.M. Sutton, P.N. Mishra and A.Janson, *Membrane Enhanced Biological Treatment of Oily Wastewater*, Water Pollution Control Federation Conference, Washington, DC, 1990.

PAPER FIBER SOIL ENRICHMENT PROGRAM

THE MANAGEMENT OF PAPER SLUDGE

presented by:

TODD DUPUIS
– ATLANTIC PACKAGING PRODUCTS LTD –

ERIC PRINGLE
– GARTNER LEE LIMITED –

ABSTRACT

Paper fiber sludge is a by–product of paper recycling processes. As such, its management must be an integral part of the Provincial Government's policies to promote the 3Rs and part of industry's plans to build and operate recycling facilities. Without cost effective and proper waste management options, paper sludge can threaten the viability of such facilities.

Atlantic Packaging Products Ltd. is a leader in the use of recycled paper as a feed stock in the manufacturing of new paper products. Atlantic Packaging operates two recycling facilities in Southern Ontario, one in Scarborough, the other in Whitby. The latter is a state of the art facility that produces tissue paper and newsprint with 100 percent recycled content.

Atlantic's mills also generate approximately 110,000 tonnes of paper sludge annually.

This paper provides an overview of the management program implemented by Atlantic Packaging to utilize paper sludge as an organic soil conditioner on agricultural lands. While other options were considered, land application of paper sludge is preferred for a variety of reasons, including cost, control, and operational considerations. The program, initiated in August 1991 and christened the Paper Fiber Soil Enrichment Program, incorporates a field program and an extensive management program.

As the Atlantic Packaging program enters its second year, paper sludge has been approved for use on almost 10,000 acres of land at no expense to the farmer.

This paper was presented at the 39th Ontario Conference on the Environment and provides an overview of the management program developed by Atlantic Packaging and Gartner Lee to utilize paper fiber sludge as an organic soil conditioner.

Eric Pringle, P.Eng., is a Project Manager with Gartner Lee Limited and is responsible for coordinating the Paper Fiber Soil Enrichment Program for Atlantic Packaging Products Ltd. Gartner Lee Limited is a multidisciplinary consulting engineering firm providing professional services in environmental management.

Todd Dupuis is the assistant to the General Manager for Atlantic Packaging Products Ltd. and, among his many other duties, is responsible for the Paper Fiber Soil Enrichment Program.

1.0 THE PAPER FIBER SOIL ENRICHMENT PROGRAM

The Paper Fiber Soil Enrichment Program was created in 1991 by Atlantic Packaging Products Ltd. to utilize paper sludge as an organic soil conditioner on farmland and in the rehabilitation of pits and quarries.

Paper sludge is a by-product of recycling processes developed to use waste paper as a feed stock to produce new paper products.

Atlantic Packaging operates two paper recycling facilities in Southern Ontario. Each facility houses two mills or paper machines. The Progress Avenue mills in Scarborough use recycled waste paper and cardboard to make paper towels, tissue paper, liner board, and corrugated material. The newest mills, located in Whitby, were opened early in 1991 and use recycled paper, magazines, and newspapers to make tissue paper and newsprint. The Whitby newsprint mill is one of only two mills in Canada capable of utilizing 100 percent recycled newsprint or magazine material as feedstock.

As users of recycled paper products, the Atlantic Packaging mills are essential to provincial recycling efforts and local "Blue Box" programs. Atlantic Packaging's mills are estimated to consume approximately 400,000 tonnes of recycled material annually. Roughly 40 percent of this total is expected to be old recycled newsprint.

Atlantic Packaging's recycling efforts were recently recognized by the Recycling Council of Ontario (RCO) at their Waste Minimization Awards Dinner. Atlantic Packaging was selected to receive the RCO's Chairman's Award for outstanding achievements in the areas of waste reduction, reuse, and recycling. The award was presented to recognize Atlantic Packaging's "establishment of a 100 percent recycled content newspaper deinking mill and related efforts regarding the management of process by-products".

The by-product is paper sludge and the efforts to manage the by-product are part of the Paper Fiber Soil Enrichment Program.

2.0 PAPER SLUDGE

2.1 PROCESSED ORGANIC WASTE AND ORGANIC SOIL CONDITIONER

While paper sludge is a by-product of recycling activities, it is classified by the Ontario Ministry of the Environment (MOE) as a processed organic waste. As such, any program to manage the material requires a Certificate of Approval under Part V of the Environmental Protection Act (EPA).

Accordingly, the Paper Fiber Soil Enrichment Program is a waste management project. However, it is also a "***good news***" project. By land spreading paper sludge, the Paper Fiber program completes the recycling loop in a beneficial manner, returning organic matter to the soil and, thereby, improving the structure and tilth of the receiving soil.

The MOE and Ministry of Natural Resources (MNR) have both recognized the cost effective and beneficial aspects of using paper fiber sludge as an organic soil conditioner on agricultural land and in the rehabilitation of pits and quarries.

The priority and challenge for all parties involved in the Paper Fiber program has and will continue to be the operation of a beneficial program and not a disposal option.

2.2 WHAT IS PAPER SLUDGE?

Paper sludge is a solid material, which typically has a dark brown or grey colour and an earthy texture. Once processed, paper sludge is granular, with pebble-sized particles resembling small balls of wet paper rolled between your fingers.

Paper sludge consists of small wood fibers and fillers. The wood fibers are typically too small to be used in the making of new paper products and are washed out in the pulping, de-inking, and water treatment processes. The fillers are typically clay and/or lime. These are added, not by Atlantic, but by the original mill to give paper strength and a smooth, bright writing surface.

Atlantic Packaging's paper sludge typically has a solids content of 35 to 45 percent and an organic content of 20 to 50 percent. It is not a fertilizer, having less than 1 percent nitrogen on a dry weight basis.

Concentrations of metals and even dioxins and furans are closely monitored. All are well within regulatory guidelines.

2.3 LAND SPREADING OF PAPER SLUDGE

The use of various types of sludge as an organic soil conditioner is not new. For example, the Regions of Durham and Halton and the Counties of Northumberland, Dufferin, Peterborough, and Hastings have operated successful ***municipal sewage sludge*** spreading operations. As well, Noranda Forest Inc. and Quebec and Ontario Paper Company have successfully spread ***paper sludge*** on farmland, in pits and quarries, and on industrial land in the Niagara Region for years.

The Atlantic Packaging's Paper Fiber Program will build upon these established programs.

3.0 ATLANTIC PACKAGING PRODUCTS LTD.

Atlantic Packaging was founded in 1945 as a family run business. In 1945, the company was named Atlantic Paper Products and its main business was the manufacturing of paper bags.

Today, in 1992, Atlantic Packaging manufactures over two dozen different products, including

- paper towels;
- tissue paper;
- polyethylene film and bags;
- liner board and corrugated material;
- newsprint and, of course;
- the original paper bags.

Atlantic Packaging has been using 100 percent recycled materials in their corrugated operations since 1968. With the start-up of their Whitby facility in 1991, Atlantic Packaging is now truly a leader in the field of making paper products from recycled paper.

Their recycling facilities are a key component of our provincial waste management strategies to reduce, reuse, and recycle.

Atlantic's mills use approximately 400,000 tonnes of waste paper per year, including:

- old newsprint;
- old magazines;
- used corrugated cartons and boxes; and
- recycled black and white ledger.

3.1 THE WHITBY MILLS (100 PERCENT RECYCLED PAPER PRODUCTS)

The Whitby facility was a first for Atlantic and a first for Canada. It is a state of the art, fully automated, de-inking facility utilizing 100 percent recycled paper to make newsprint and tissue paper. It is still only one of two such facilities in Canada.

The recycling processes at the Whitby (and Scarborough) mills include paper recycling and conventional paper mill steps:

Paper Recycling Steps:

- receipt and storage of recycled paper;
- pulping processes;
- de-inking systems;

Conventional Paper Mill Steps:

- paper machines or mills; and, finally,
- finished paper products.

At the Whitby mill, the large quantities of water used in the recycling and paper making processes are treated at an on-site water treatment plant. This last step, the treatment of waste water, is ultimately the start of the Paper Fiber Soil Enrichment Program.

Atlantic employs a series of smaller primary clarifiers; followed by two large primary clarifiers; a biologically active, secondary clarifier; and a sand filter to treat waste water.

Solids from the water treatment plant are dewatered using belt presses and screw presses. The result is paper sludge.

At capacity the Whitby and Scarborough mills will generate an estimated combined average of approximately 110,000 tonnes of paper sludge annually. To put the magnitude of this potential waste management problem in perspective, in 1991, the Regional Municipality of Durham (population approximately 390,000 in 1991) generated approximately 114,000 tonnes of solid residential waste.

4.0 PAPER SLUDGE WASTE MANAGEMENT OPTIONS

With a limited number of economically viable and government approved options for managing paper fiber sludge, Atlantic Packaging has until recently been forced to use landfilling options or to haul to land application and composting facilities in the Niagara Region. However, these options are costly (requiring Atlantic to pay both haulage costs and a tipping fee) and, because they are operated by independents, do not allow Atlantic to control the long-term costs.

Atlantic Packaging therefore decided to develop their own program to utilize paper sludge. The program was developed with the following objectives in mind. However, they specified that the program had to be:

- cost effective;

- environmentally safe and, preferably, involve a beneficial use for the material;

- flexible and capable of handling the large volumes of material generated annually; and

- easy to operate and easily incorporated into Atlantic Packaging's business of making paper products, not waste management.

In assessing the various waste management options, Atlantic Packaging considered the following technologies:

- composting;
- incineration;
- land spreading; and
- manufacturing operations.

4.1 INCINERATION

Incineration was discounted as an option due to the marginal fuel value of paper sludge; the need for ash management or disposal; and the lack of available users. As well, the general lack of political and public support for incineration technologies made it an unlikely solution.

4.2 MANUFACTURING OPERATIONS

The use of paper sludge in certain manufacturing operations as a raw material was reviewed and still holds considerable potential. Atlantic Packaging has discussed opportunities with the gypsum board and cement industries. The advantages for the receiving company are clearly lower costs for raw materials.

Even environmental approvals are greatly simplified with this option. If paper sludge can be wholly utilized by the manufacturing process and repackaged for retail sale, it can be classified as a recyclable material and exempted from registration requirements for waste materials.

However, problems were encountered, not in meeting the regulatory requirements, but in meeting the strict process specifications of the industries approached. Gypsum board manufacturers require an organic content of less than 2 percent. The cement industry typically looks for a moisture content of less than 10 percent. Both specifications are significantly lower than those of paper sludge.

The challenge has been to deliver a consistent product, with acceptable characteristics, so that the receiving company can use paper sludge without having to reformulate other raw materials or reconfiguring their processing operations. At this stage, Atlantic and several companies are still pursuing the possibilities.

One interesting success has been the use of paper sludge in the manufacturing of kitty litter. The absorbant qualities of paper sludge make it an ideal raw material. At present, several loads of paper sludge have been delivered to the company and product trials are continuing.

4.3 COMPOSTING

As mentioned previously, Atlantic Packaging has used composting operations in the Niagara Region in the past. However, the high tipping fees combined with haulage costs make this option prohibitive. No local composting operations are currently approved to accept paper sludges. Atlantic Packaging is, however, pursuing this option.

4.4 LAND APPLICATION AS AN ORGANIC SOIL CONDITIONER

After several years of investigating the options, Atlantic Packaging decided to develop their own program to utilize paper sludge as an organic soil conditioner for land application.

Atlantic Packaging realized that, with some outside help, they could quite effectively operate the program themselves without becoming a waste management company and without losing sight of their main purpose as a producer of paper products.

The Ministries of the Environment (MOE) and Natural Resources (MNR) both approved of the program. Their approval was clearly predicated on the program being operated in an environmental safe, beneficial, and responsible manner. Both recognized the potential benefits.

Further, the option to use paper sludge as an organic soil conditioner provided some diversity. Paper sludge could be use on agricultural land as a source of organic matter; it could be used in the rehabilitation of pits and quarries; and even in the rehabilitation of commercial and industrial land.

Currently, Atlantic Packaging has only received approval for the agricultural component of the program. However, a project to demonstrate the benefits of paper sludge use in the rehabilitation of mineral spoils at the pit sites in the Region of Durham was initiated in 1991 and the results are currently being compiled.

The agricultural program was approved by the MOE in August 1991 with the issue of a Certificate of Approval. Interestingly, the Certificate was issued jointly to Atlantic and their hauler, Ontario Disposal, a division of Courtice Auto Wreckers Limited.

Paper sludge is currently supplied by Atlantic Packaging to interested farmers at no cost. In the last 10 months, over 110 farms have been enrolled and approved for the program. Almost 10,000 acres of land have been approved, although not all have been spread.

5.0 THE PAPER FIBER SOIL ENRICHMENT PROGRAM

There are two separate, but related, components of the Paper Fiber program. They are:

- an operational component, which incorporates the physical hauling and spreading the material; and
- a management component, which involves ensuring that the overall program is operated properly and in accordance with the Certificate of Approval.

5.1 FIELD PROGRAM

The components of the field or operational program include:

- interim, short–term storage at the mills;
- delivery to the sites;
- stockpiling at the sites;
- spreading operations;
- addition of supplementary nitrogen; and, finally,
- planting.

5.1.1 Storage and Delivery

Atlantic Packaging generates approximately 350 tonnes of paper sludge per day. Clearly, storage prior to spreading is an important feature of the program. Unfortunately, the storage facilities associated with and permitted by the Certificate of Approval are limited.

A small volume of paper sludge, not to exceed 1000 tonnes, can be stored at each plant. As well, paper sludge can be stockpiled at the farm site where it is to be spread. However, poor weather can easily make farm sites and fields inaccessible, quickly causing several days production of paper sludge to accumulate at the mills.

The handling of paper sludge once generated, including all transportation and spreading, is coordinated by Courtice, who are under contract with Atlantic and, as mentioned earlier, are joint holders of the Certificate of Approval.

5.1.2 Spreading

Paper sludge is typically spread at a rate of 30 tonnes wet weight per hectare (12 tonnes wet weight per acre) and can be spread annually. A modified side discharging manure spreader is used for applying paper sludge.

Spreading operations are highly dependant upon planting and harvesting schedules and upon weather and field conditions. Paper sludge is not currently permitted to be spread during winter months when the ground is frozen and cannot be spread during wet field conditions.

5.1.3 Supplementary Nitrogen

Once spread, additional or supplementary fertilizer is added to the paper sludge. The additional nutrients, particularly nitrogen, are needed by the micro–organisms in the sludge as part of the natural decomposition process. Atlantic has currently agreed to pay for the cost of this additional fertilizer. The supplementary nitrogen and usual crop fertilizer are applied by the farmer at the same time and in the same manner, typically just before planting.

5.1.4 Planting

The planting of crops is carried out in the usual way by the farmer. Paper sludge can be used in fields were traditional farm practises are used and in fields where newer, no tillage methods are employed.

5.2 MANAGEMENT PROGRAM

The management program developed by Atlantic Packaging and Gartner Lee incorporates the following components:

- public liaison;
- site selection and review;
- approval by the MOE;
- environmental monitoring; and
- a benefit study.

The extensive efforts to operate the Paper Fiber program are necessary to ensure that the program is a benefit and not simply a disposal option.

5.2.1 Public Liaison

Public liaison is perhaps one of the most important aspects of the program. In addition to returning and following up on every enquiry or phone call, neighbours adjacent to all approved farms are sent a flyer, delivered by hand, explaining the program and asking them to contact Atlantic with any questions or concerns.

As well, a newsletter has been prepared and delivered to all the farmers, landowners, municipalities, and other interested and involved parties.

Following the delivery and spreading of paper sludge, farmers are contacted to ensure they are satisfied with the program and to solicit their suggestions for improving the program.

5.2.2 Site Selection and Review

Sites are selected and enrolled in the program at the request of the farmer, either the land owner or perhaps a tenant farmer. In all cases, the owner of the land is contacted.

Enrollment is no guarantee of participation. After a site is signed up, Gartner Lee conducts a thorough review of each site. Ontario Base Maps (OBMs), air photos, and geology and soils maps are reviewed to ensure features and conditions at the site are clearly understood. A site visit and interview of each property owner is conducted to confirm soil and surface water conditions, farm practises, slopes of land, the location of wells and houses, and the areas to be spread.

For every site, a site plan is produced from a 1991 air photograph. The plan indicates all the features just discussed and clearly indicates where paper sludge can and cannot be spread.

However, farms are still not approved. A three page application and the site plan must be submitted to the MOE for each site. Only when finally approved by the MOE is the site able to receive paper sludge and participate in the program.

5.2.3 Environmental Monitoring

In addition to the site review and approval process, a monitoring program has been established to test the following:

- *paper sludge* generated at both the Whitby and Scarborough mills is sampled each week and a composite sample is analyzed monthly;

- *soil* and soil quality are monitored at selected sites, both before and after paper sludge is spreading; and,

- *ground water* quality is monitored monthly at selected sites.

5.2.4 Benefit Study

As part of the Paper Fiber program, Atlantic Packaging and Gartner Lee have initiated a field study to document the benefits to soil structure and crop response. The services of Kevin Bellamy from Ortech International and Dr. Tom Bates, a retired professor from Guelph University and an expert in the use of wastes on agricultural land, have been enlisted to assist in the field tests.

Upon completion of the study, an information package and results will be made available to interested parties and tours of the study plots will likely be conducted. Every effort will be made to provide information to the farmers, the community, and the supporting municipalities.

The benefit study was initiated in 1991 and the results will likely be reported in November 1992, after harvest.

While the benefit study will document the benefits associated with Atlantic Packaging's program, paper sludge has been used as an organic soil conditioner for many years in the Niagara Region. The benefits there have included:

- improved tilth and structure;
- improved moisture retention;
- improved nutrient retention;
- erosion control; and
- suppression of weeds.

It must be emphasized that benefits to soil and subsequently, to crop response are not immediate, but long-term, with paper sludge being applied annually. However, another, immediate benefit, that should not be overlooked, is related to the strength and viability of Provincial recycling programs.

6.0 DISCUSSION - ISSUES AND NEXT STEPS

The Paper Fiber Soil Enrichment program has now operated for almost one year. To date, the program has been very well received by the farm community and the townships in which it is operated. While Atlantic Packaging and the MOE have exerted a significant level of effort during this first year to initiate the program and make it a success, it is clear that the work must continue.

Three of the greatest challenges to be tackled in the second year of the program are:

- operating within a complex regulatory framework and according to guidelines which are not specific to paper sludge;

- dealing with public perceptions of paper sludge; and

- initiating operational changes and controls within the Atlantic Packaging mills to produce and manage paper sludge as a product.

Atlantic Packaging has recognized the benefits of utilizing paper sludge as an organic soil conditioner. To ensure the Paper Fiber program's long-term success they have initiated a program to manage the spreading of paper sludge on agricultural land and are developing a program to use paper sludge in the rehabilitation of pits and quarries. The field programs to study and document the benefits of paper sludge on agriculture and in the rehabilitation of pits and quarries are fully underway and, to our knowledge, are the only such field studies in the Province.

To be a resource, paper sludge must be treated as a product. Atlantic Packaging and Gartner Lee are reviewing ways to improve and control the quality and consistency of the material. This will enhance the use of paper sludge as an organic soil conditioner and as a raw material for manufacturing operations.

As well, efforts are continuing to coordinate with and communicate to the farm community the benefits of using paper sludge as an organic soil conditioner (i.e., best management practises on how and where to use paper sludge).

With regard to regulatory issues, the MOE and the Ministry of Agriculture and Food (OMAF) have a joint committee to develop guidelines for the use of wastes and sludges, other than sewage sludge, as soil conditioners on farm land. These new guidelines, while not specific to paper sludge, are expected to be more appropriate than the sewage sludge guidelines currently being used to regulate paper sludge operations.

It is important that a reasonable approach be developed by the MOE and paper recycling companies, such as Atlantic Packaging. After all, paper sludge is a by-product of the recycling policies that the MOE is endorsing, promoting, and regulating. The significant volume of paper sludge generated by Atlantic Packaging is partially due to the low grade of paper products, such as magazine stock, that the Whitby mill accepts and is capable of recycling. Without state of the art recycling plants, like Whitby, 100 percent recycled newsprint and the use of low grade paper products will not be possible.

The Paper Fiber program operated by Atlantic Packaging has successfully closed the loop for paper recycling. The program uses paper sludge as a resource and provides an alternative to disposing of the material as a waste.

IN-PLACE BIOREMEDIATION OF CONTAMINATED SEDIMENTS IN HAMILTON HARBOUR AND ST. MARY'S RIVER BY DR. TOM MURPHY

Lakes Research Branch, National Water Research Institute, Burlington, Ontario

ABSTRACT

Pilot-scale in place sediment treatments have been done in water up to 21 m deep. The chemical injection system treated sediments to a depth of 15 cm. The system used in 1991 treated about 89% of the surface sediments in the experimental area. In 1991, a ferric chloride injection into the St. Marys River sediments decreased the concentration of hydrogen sulphide and acute toxicity of the sediments by 81% and 57%, respectively.

The biodegradation of many organic compounds is restricted in the sediments of Hamilton Harbour and the St. Marys River by anoxia. During summer, microbial decay produces the toxin hydrogen sulphide and its presence signals the blockage of PAH biodegradation. Maximum observed concentrations of hydrogen sulphide were 4 and 100 mg/kg in St. Marys River and Hamilton Harbour sediments, respectively.

In laboratory incubations, the addition of calcium nitrate to these sediments stimulated microbial denitrification and the oxidation of reduced sulphur to sulphate. The oxygenation of the sediments eliminates acute toxicity and stimulates the biodegradation of some compounds. In six week incubations, about 25% of the "oil and grease" is biodegraded. Although biodegradation of naphthalene is observed in headspace GC/MS analysis, this observation is compounded by other observations that naphthalene appears to be produced during breakdown of larger compounds. Calcium nitrate is a more effective oxidant than ferric chloride and pilot-scale injection of calcium nitrate into sediments began in 1992.

Editors Note: The above Abstract was received before the Conference. At the time of Proceedings assembly, a full text of the author's paper had not been submitted for inclusion in the numerical sequence. If the paper was subsequently received, it is incorporated following the Delegate listing.

Otherwise, those wishing further details on this subject, are asked to contact the author direct.

MFC
9/22/92

LANDFILL MINING

By Richard Cave

President, R.Cave and Associates Ltd.
Oakville, Ontario

INTRODUCTION

Landfill mining is a process involving the excavation and separation of landfilled waste to recover materials, remediate ground water contamination and rehabilitate the site.

Landfill mining has been pioneered in the United States and Europe as a method for RECLAMATION; REMEDIATION; AND REHABILITATION, otherwise known as the 3R's of landfills.

RECLAMATION has involved the recovery from existing sites of; metals, organics, paper and plastic. REMEDIATION of ground water contamination is achieved through the excavation of source of the contamination and placement in a contained area on site. REHABILITATION of the landfill site is achieved through the excavation of all the materials and disposal elsewhere.

My presentation today provides a brief overview of landfill mining projects in North America and Europe followed by a description of the mining project under way in the

Township of McDougall, near Parry Sound.

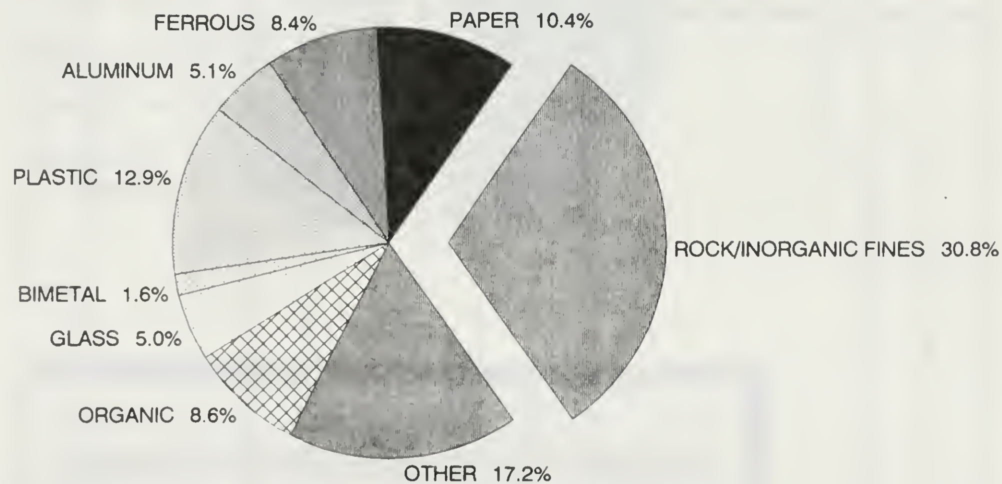
EXAMPLE PROJECTS

Florida

The first landfill mining project in the United States was at the Naples Landfill site in Collier County, Florida. In 1987 the County the owner of the site, investigated the feasibility of extracting daily cover materials from the landfill and the recovery of combustible materials for use in a planned energy from waste incinerator. While the EFW facility was never built the County was successful in recovering cover materials at a lower cost than importing cover soils. The County continues to test technologies to separate materials suitable for recycling.

A 26 acre landfill cell at the Naples site, which was closed in 1979, was selected as the area to be mined. Initially the excavated materials were screened using vibratory double deck screens with a capacity of 90 tonnes per hour. Later test screening involved a grizzly screen and hopper, belt feed conveyor, followed by a trommel screen. Fines and overs from the screen was discharged onto separate stacking belt conveyors. The trommel screen approach was more effective in maximizing the recovery of fine materials from the wastes. The results indicated that between 60 and 75 percent of the landfilled materials were recovered as fines suitable for use as cover materials. Only metals were recovered and recycled. Overall the costs of the mining and screening amounted to $3 per tonne compared with $4 per tonne for imported cover materials.

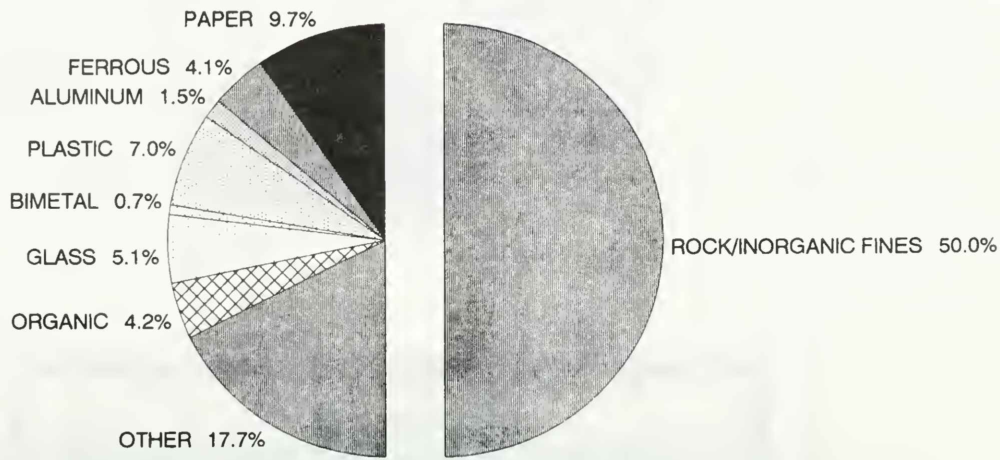
COLLIER COUNTY
WASTE COMPONENTS OF LANDFILL
(by volume)



COLLIER COUNTY

WASTE COMPONENTS OF LANDFILL

(by weight)



The County as a result of the success of the program has developed new design and operation approaches for future landfill cells which incorporates enhanced decomposition processes coupled with landfill mining techniques. The University of South Florida is assisting the County in assessing alternatives including both anaerobic and aerobic waste decomposition processes within the landfill cells.

Edinburg, New York

In 1988, departments of New York State initiated a research, development and demonstration project on procedures and equipment for reclaiming landfilled materials. The Edinburg landfill site, selected as the site for the project, is located in Saratoga County near Albany New York. One acre of the 5 acre site was totally excavated and screened.

Different types of screening equipment were tested and a trommel screen was selected for the project with a capacity of approximately 150 cubic yards per hour. Increasing the length of the 10 ft long trommel is believed to be required to obtain optimum soil recovery.

Unlike the Florida project, the soils recovered from the landfill were to be used as a fill material off site in public works projects and therefore had to be declassified as a waste. The results of analyses of the soils recovered during the demonstration resulted in the declassification of the soils being approved since results indicated the soils were below compost standards set by the State .

A comprehensive health and safety plan was implemented during the project and monitoring of gases released during excavation, asbestos fibre content and radiation were all measured. Operators at the site were provided with full face respirators, tyvek overalls and chemical resistant boots and gloves. However results of the monitoring did not indicate the need for such protective equipment.

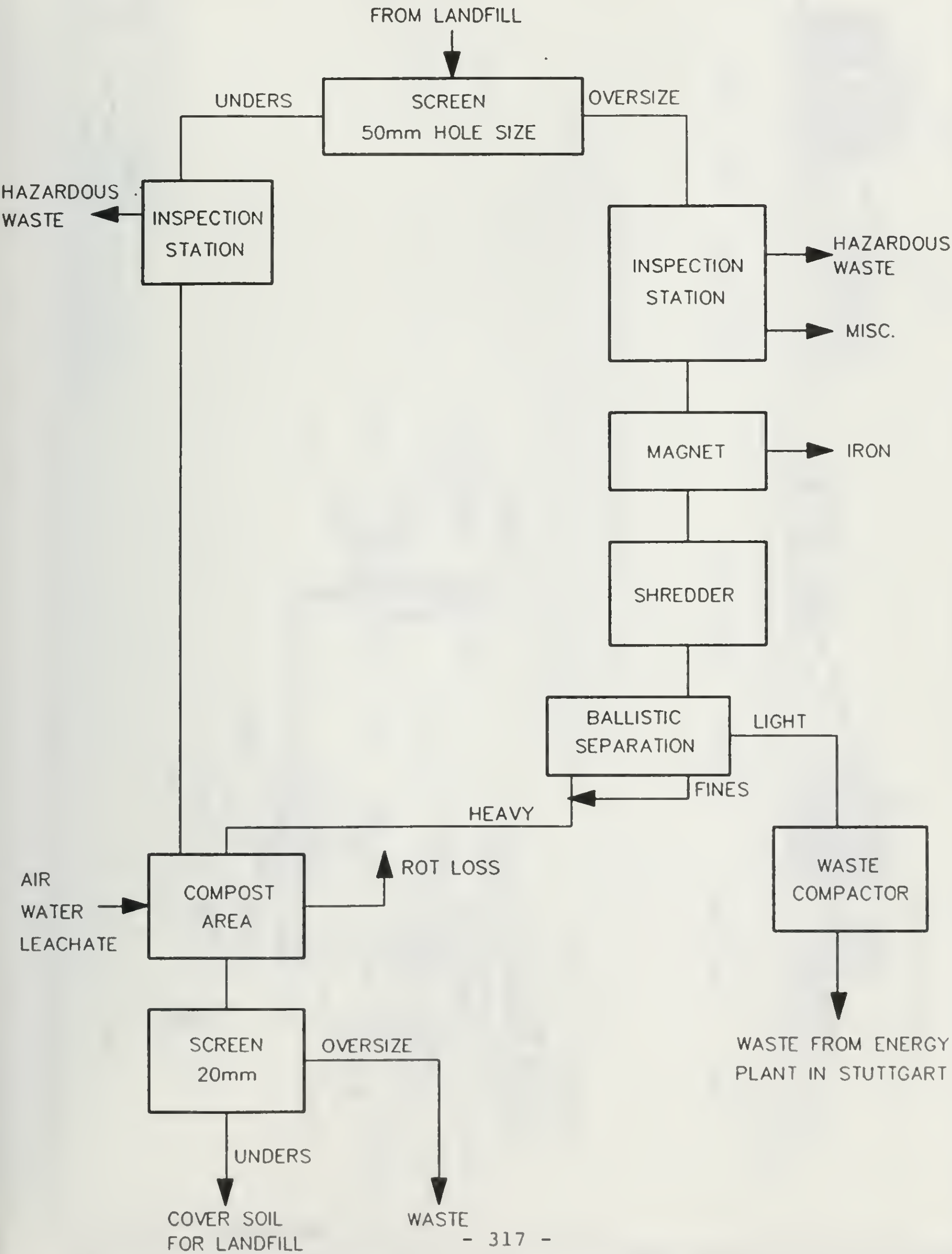
Ludwigsburg, Germany

A demonstration project in Ludwigsburg involves the mining of 40,000 cubic meters of landfill materials over one year. The demonstration is intended to provide detailed information required prior to mining the whole site of 8 million cubic meters. Mining of the materials is required to provide landfill site capacity in an area where new landfill sites are very difficult to obtain.

Excavated materials are first screened in a trommel screen with 50 mm holes. The soil or unders are to be composted to remove any remaining volatile solids. The oversize materials are conveyed through an inspection station for removing potentially hazardous materials utilizing a remote controlled sorting arm. Ferrous metals are removed by a magnet following which the materials are shredded to minus 75 mm. Shredded light materials are separated by a ballistic separator and shipped for combustion in a energy from waste plant in Stuttgart.

At this site air treatment systems are to be employed prior to excavation to treat the odours

LUDWIGSBURG DEMONSTRATION PROJECT PROCESSING PLANT FOR LANDFILL MATERIALS



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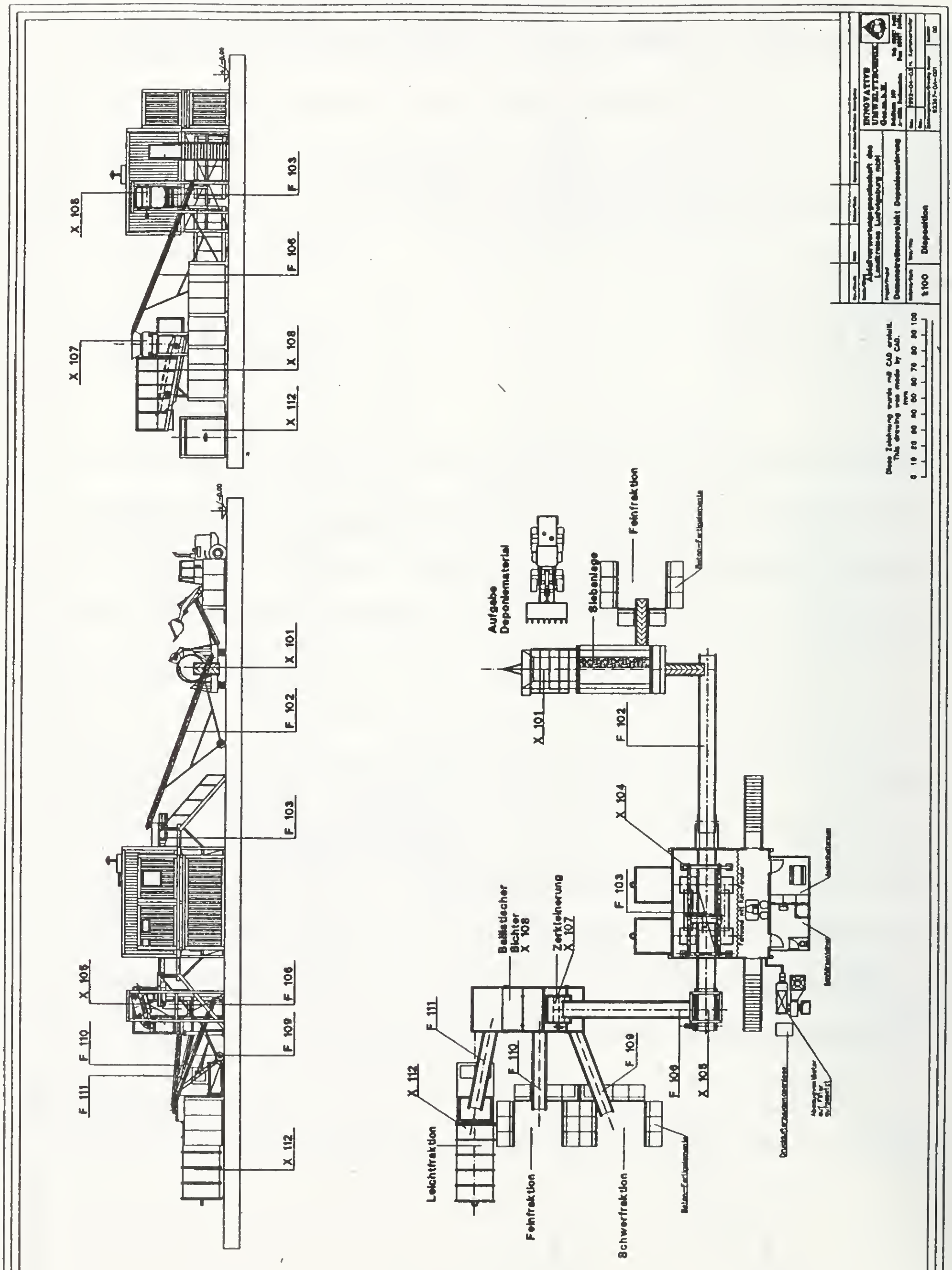
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Feinfraktion
Schwerfraktion
Ballistischer Sichter X 108
Zerkleinerung X 107
F 108
X 104
Aufgabe Deponiematerial
Siebanlage
Diese Zeichnung wurde mit CAD erstellt.
This drawing was made by CAD.
INNOVATIVE UMWELTTECHNIK
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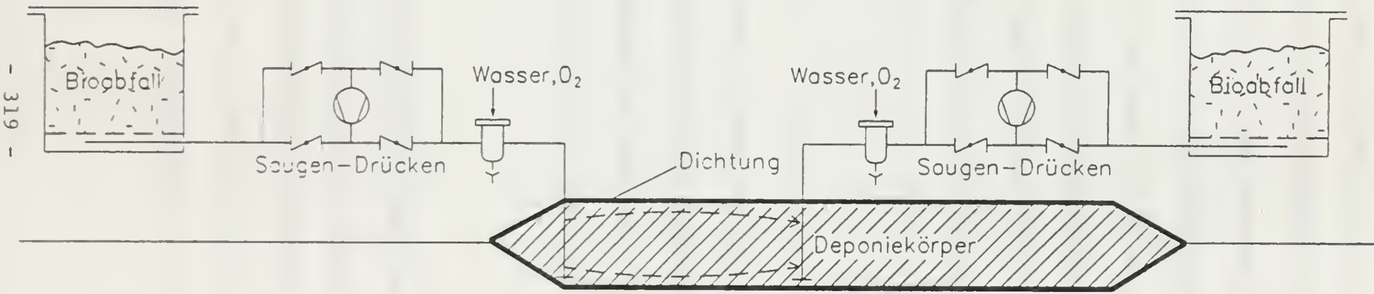
Deponie – Stabilisierung



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produced from anaerobic conditions in the landfill and to treat for toxic gaseous compounds such as chlorinated hydrocarbons. The treatment system is modelled after one used in the mining of a landfill on the site of the worlds fair in Vienna. The treatment process involves converting the anaerobic conditions within the area to be excavated to aerobic conditions. An air lance is installed into the landfill to be excavated and air, enriched with oxygen, is blown into the landfill through the lance. A second lance typically 10 to 15 meters from the first withdraws air from the landfill and discharges it through a biofilter. In Vienna a similar system eliminated the foul anaerobic odours over 30 hours of operation.

McDougall Township

The McDougall Township landfill site, located seven kilometres east of Parry Sound, has a site area of 74 hectares and an approved fill area of 7 hectares. The site, opened in 1976, has been accepting municipal waste from seven area municipalities. In 1989, the Ministry of the Environment directed the Township of McDougall to take over the operation of the site from the private owner.

Waste quantities disposed at the site are annually 13,000 tonnes. Summer quantities are typically over twice the winter tonnages reflecting the high seasonal population in the area. The site contains approximately 250,000 m^3 of waste with fill thicknesses ranging from 1 m to 13 m. Daily cover soil is obtained on-site and is generally a clean coarse-grained sand with gravel and boulders. Cover soil is applied daily at typical waste to cover soil volume ratio of 4:1. Most precipitation infiltrates rapidly into the soil and waste fill area, as a result in 1990, a temporary synthetic liner was applied to the oldest half of the landfill. This liner has had a minimal effect on reducing the concentrations of leachate within the ground water plume and it will not enable the site to meet the MOE Reasonable Use policy.

Leachate from the landfill has been detected beyond the site boundaries since 1983 and wells and streams around the site have been contaminated. McDougall Township, in response to the Minister's order, began site remediation by determining alternative remediation options. The options were reviewed by the Township, the MOE, neighbours of the site and area municipalities using the site. The landfill mining option was selected This option involves three steps. Firstly, excavating the existing waste. Secondly, screening to recover decomposed organic materials, cover soil and recyclable materials. Thirdly, depositing of non-recoverable materials in a landfill cell constructed with dual synthetic liners within the approved fill boundaries for the site .

Preliminary Engineering

The primary reason for excavating the waste is to enable it to be isolated from the ground water in a contained cell. Screening of the excavated materials is undertaken to reduce the amount of material requiring reburial and thereby reduce the size and costs of the required engineered cell.

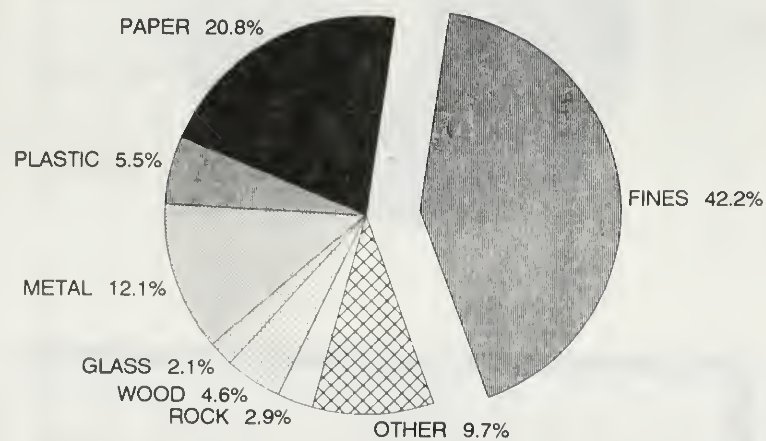
A pilot excavation and screening program is under way at the site. Preliminary tests were carried out to determine how efficient the full-scale excavation and screening would be and what problems may be expected. Therefore the tests addressed such issues as; thickness of waste; rates of excavation; odour and dust problems; screening rates; waste composition; potential for materials recovery; and weight and volume reductions through screening.

Results

Excavation production *(approx.)*	120-190m^3/hr (100-150t/hr)
Decomposition of Waste	Putrescible less than 3%
Thickness of Waste	1 m to 13 m
Odour/Dust Problems	Minimal
Waste Components	See chart
Physical Nature of Waste	See Table
Potential Materials Recovery	See Table
Potential Weight and Volume Reductions	See Table

The screening plant used was a mobile rig supplied by Masterskreen. The plant included grizzly screen mounted on top of a feed hopper. A belt conveyor feeds the waste from the hopper into a trommel screen which has 25 mm holes, overs being discharged from the end of the trommel screen by conveyor. The unders are discharged from under the trommel to trucks by a third belt conveyor.

MCDOUGALL LANDFILL
WASTE COMPONENTS OF LANDFILL
(by volume)

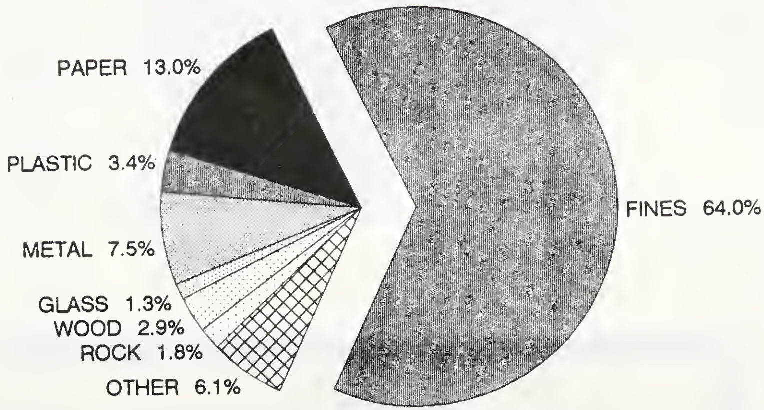


R. CAVE AND ASSOCIATES

MCDOUGALL LANDFILL

WASTE COMPONENTS OF LANDFILL

(by weight)



R. CAVE AND ASSOCIATES

Full scale project

Using conventional hydraulic hoe excavators it is possible to excavate material at a rate of $150m^3$ per hour using one excavator. Total excavation of the site could therefore be completed in 9 months. The preferred type of screen would be a trommel based on our experience with screens and also at other projects. Production rates for a trommel screen is expected to be in excess of 150m3 per hour.

The screen is expected to be loaded direct from the excavation by the hoe excavator. Products from the trommel screen will be discharged by conveyor direct to trucks for haulage to stockpile or the containment cell. A front-end loader will load rejects from the trommel and grizzly screen into trucks. Approximately four trucks per screen are required.

A volume reduction of from 40% to 50% is expected by the screening of the excavated waste. The oversize from the screening process contains a large percentage of biodegradable paper ~ 37% by volume of the remaining waste. If this waste could be further composted after the initial screening a further 20% of the total waste volume could be reduced. The recovery of further materials is not presently being considered. Metals are the next potential waste component to be recovered. We expect to perform some pilot testing of the feasibility of recovering metals from the waste.

Finally, the costs of this project will amount to approximately $1.9 million for the excavation, screening and reburial or approximately $11 per tonne, the containment cells will cost approximately $2.9 million or approximately $25 per tonne.

CONCLUSIONS

Landfill site mining has been shown to be a method which can successfully and economically provide; additional capacity within certified landfill sites; minimize landfill site closure costs and long term monitoring costs; provide opportunities for recovery of materials; and remediate leachate contamination of ground water. Results from the Township of McDougall project will be invaluable in contributing to the knowledge and experience of landfill mining techniques.

R.CAVE AND ASSOCIATES

JUNE 5,1992

MCDOUGALL LANDFILL
WASTE SCREENING TEST

MATERIAL CLASSIFICATION

SCREEN SIZE mm	PAPER % RETAINED	PLASTIC % RETAINED	METAL % RETAINED	GLASS % RETAINED	WOOD % RETAINED	OTHER % RETAINED	ROCK % RETAINED	TOTAL %
203.2	31.16	8.27	45.31	0.00	4.93	10.33	0.00	100.00
152.4	60.86	4.89	4.89	0.00	1.53	18.65	9.17	100.00
101.6	20.99	20.99	11.13	0.43	16.49	29.76	0.21	100.00
50.8	37.29	7.46	19.15	6.27	9.66	14.92	5.25	100.00
25.4	41.25	2.50	2.50	17.08	4.58	10.83	21.25	100.00

Tabulated data are percent of total weight retained on each screen size.

CLEAN-UP OF CONTAMINATED PORT OF TORONTO INDUSTRIAL LANDS

by
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The Toronto Harbour Commissioners,
Toronto, Ontario

1. INTRODUCTION

1.1 Legacy of Contaminated Industrial Lands

The dilemma surrounding efforts to redevelop contaminated industrial lands in Toronto encompasses these conditions:

- past industrial uses that operated within the legislated requirements of their day have often left the lands they occupied contaminated by today's standards.
- current regulations require that these contaminated lands be cleaned, somehow, before redevelopment will be permitted.
- techniques to be applied to clean these contaminated lands must be affordable to those paying for the clean-up and acceptable to those regulating the clean-up.
- the clean-up must also be acceptable to polluters, land owners, developers, lenders and insurers, who require that their investment in the clean-up costs and their concerns for ongoing or future liability for additional clean-up that may be imposed by the regulators will be protected over a sufficiently long term.

The contaminated industrial land being addressed in this paper is land where the contamination is not so great that the environmental authorities are ordering clean-up at any cost, but where the contamination is sufficiently great that redevelopment on those lands will not be permitted until the contamination is somehow decreased.

Generally, such moderately contaminated soils can be disposed of in licensed landfills, and that has been the predominant means of cleaning up such contaminated industrial lands to date. However, in the greater Toronto area, licensed landfills are rapidly approaching their capacity and there is considerable resistance to developing new landfill sites or to expanding existing sites. Currently available landfill capacity is at a premium and is being reserved for the disposal of municipal waste. Tipping fees at licensed landfills operated by the Municipality of Metropolitan Toronto have increased from $10.42 per metric tonne in 1981 to $150.00 per metric tonne in 1991, and it appears probable that this increase in disposal fees will continue.

Furthermore, the removal of contaminated soil from an industrial site to a landfill site does not eliminate the environmental contamination problem associated with the soil, it merely moves it from one location to another. Granted, the licensed landfill storage of the contaminated soil will likely reduce the environmental risk presented by the contaminated soil, compared to the risk of redeveloping on the contaminated lands, but it results in land areas being sterilized for storage and removes the soil and the land from further productive use.

The Toronto Harbour Commissioners own over 200 hectares of industrial land in the Port of Toronto. As with any port, these lands are among the oldest industrial use lands in the City. Much of the land mass was created by placing fill material, much of it contaminated by today's standards, into the lake under virtually uncontrolled or unregulated conditions. Industrial uses tended towards heavy industry that required water transportation services. Industrial users changed over the decades of use provided by these lands, and the remnants of their operations have been spread indiscriminately over the land. Many of these polluting industries are no longer in existence, and the cost of cleaning up their damage to the land falls to the current land owner.

As the owner of most of the industrial lands in the Port of Toronto, The Toronto Harbour Commissioners decided to actively pursue some means of cleaning up their contaminated lands to facilitate redevelopment of the Port Industrial District with clean green industry.

This paper describes our understanding of the issues surrounding clean-up and redevelopment of contaminated industrial lands in Toronto, and our work to date to find an economically affordable and environmentally satisfactory way to clean contaminated industrial lands. The result has been to implement demonstration of a unique contaminated soil treatment facility with the capability of cleaning a cocktail of contaminants from a wide variety of soils. The paper is presented in four parts:

1. An introduction to the issues surrounding clean-up of contaminated industrial land in the Port of Toronto.

2. A description of soil remediation.

3. Presentation of the work we're doing in the Port of Toronto, as a case study of soil remediation.

4. An appended Tour Guide that describes how soil is cleaned at our Soil Recycling Demonstration Project.

1.2 Soil as Waste

In Ontario,.contaminated soil becomes a waste as soon as it is handled. There are two general categories of soil as waste: soil is a contaminated hazardous waste if it is leachate toxic as defined in Regulation 309 under the Environmental Protection Act; or, soil is a contaminated non-hazardous waste if the level of any parameter exceeds guidelines for that parameter as set out in the Ministry of the Environment's guidelines for the clean-up of contaminated lands and where the contaminants are not leachate toxic.

Regulation 309 is Ontario's principal regulation setting out definitions of wastes for the purpose of waste management in the Province. The regulations also set out standards for waste disposal sites and classify and exempt certain waste management systems. Consideration is given to the management of incinerator systems, landfilling activities, dumps, and the management of special materials such as asbestos fibres.

The regulation does not specifically address contaminated soil, nor does it offer any assistance or encouragement to decontaminate contaminated soil so that it could be delisted or deregulated and no longer considered as a waste. The fact is that even if some environmentally conscientious operator invests the time, effort and financial resources to lower the levels of contaminants in soil so that the soil meets the MOE guidelines for clean soil, that operator would then have clean soil that would now be classified as clean waste and it would still have to be disposed of either in a licensed dump or a licensed landfill. Re-use of cleaned contaminated soil was not anticipated by the authors of Regulation 309 which, as of this date, remains the law of the land.

One of my purposes in preparing and presenting this paper is to bring to your attention the need for the Government of Ontario to establish procedures to delist or deregulate decontaminated soil so that cleaned soil can be considered for what it really is - a useful productive material that is fundamental to sustaining life on earth.

Another of my purposes is to present to you an update on The Toronto Harbour Commissioners' Soil Recycling Demonstration Project, to explain our approach to solving the problem of cleaning contaminated industrial lands so the cleaned soil can be re-used as fill on the land and the land can be redeveloped.

1.3 Regulations and Policies Affecting Clean-up of Contaminated Sites

(1) Ontario Ministry of the Environment

Under the Environmental Protection Act the Province has the authority to issue clean-up orders and may do so if

(a) a contaminant is migrating onto an adjacent landowner's property.
(b) a contaminant poses a threat to human health.
(c) a proponent proposes a change in land use.

The MOE has published "Guidelines for the Decommissioning and Clean-up of Sites in Ontario - 1989" that set out specific criteria for certain parameters such as oil and grease and heavy metals, and that provide for the negotiation of site-specific criteria. Site-specific criteria usually concern only organic parameters but may include inorganic parameters where natural background levels of certain contaminants in the soil exceed the guideline levels.

The MOE are supposed to be preparing to include parameters for organic contaminants in the guidelines as well as updating the existing guidelines.

Where contaminants have been encapsulated, stabilized, vitrified or otherwise contained and where the soils containing those contaminants remain on-site after "treatment", the MOE requires that the contaminated soils be registered on the property title even though after "treatment" the soils may test clean against the MOE decommissioning guidelines.

(2) City of Toronto

Cityplan '91 recommends the following policy (see Section 4.3.5, Clause 26 of Cityplan '91) relevant to clean-up of contaminated sites:

Council shall endeavour to ensure with the appropriate government authorities, if necessary, that contaminated soil does not create a hazard for the health of natural ecosystems or the people who live, work or play within the City. To help achieve this objective, Council shall seek to ensure, with the appropriate government authorities, if necessary, that:

i) development does not occur on any site within the City that presents a health risk caused by contaminated soil, and that no development be permitted on a site containing contaminants without its risk to health being evaluated and, where appropriate, a full soil management study being completed and necessary mitigation measures employed;

ii) the mitigation measures employed do not create a health hazard within or beyond the City's jurisdiction, and

iii) contaminated soils are cleaned up.

In another part of Cityplan '91, in Section 7.4.3.2 where the discussion relates to discouraging loss of city industry, the following policy is recommended:

The existing Official Plan policy respecting the redesignation of industrial lands through Part II study (approved December 14, 1989) should be changed to read as follows:

Council will not consider redesignation of industrial land so as to permit any non-industrial use in areas designated in Part I or Part II of this plan as ***Area of Industry, Restricted Industrial Area, General Industrial Area,*** *or* ***Heavy Industrial***

Area without first having considered a study of the area undertaken for the purposes of recommending policies for adoption in Part II of this Plan. Council will not effect such redesignation except by adoption of policies as may appear appropriate in light of the study, in Part II of this Plan. Amongst other things, such study shall have regard for:

i) the number and types of industrial firms and employees in the areas that would be adversely affected;

ii) the impact on any surrounding industrial lands that would not be redesignated; and

iii) the environmental condition of the lands and the need for soil decommissioning.

Clearly, the City wants contaminated industrial lands cleaned up to safe limits before redevelopment will be allowed.

The City turns the MOE guidelines into regulations by making clean-up to guideline levels a condition to receive approvals necessary to proceed with redevelopment of contaminated lands.

1.4 Other Regulatory Factors Influencing Clean-Up Costs

Other regulatory factors that influence cost of clean-up include the setting of permissible levels of contamination for the proposed land use, the depth to which soil clean-up will be required, requirements for treatment of contaminated groundwater, acceptable/approved clean-up technologies, community consultation programmes including public hearings, and pollution abatement and monitoring requirements during and after clean-up.

1.5 Non-regulatory Factors Influencing Clean-Up

The principal non-regulatory factor influencing clean-up cost is the need to clean land to be redeveloped such that following clean-up there is no registration of contamination on the property title, and hence no environmental-related liability to a prospective owner or developer of those lands.

In Ontario today, lenders are increasingly refusing to lend any developer any funds to construct and operate any kind of development on contaminated land or on "cleaned" land where there is contamination registered on the property title. Our current laws provide for the regulatory authorities to hold even an occupier of a contaminated site responsible for clean-up if clean-up is ordered, irrespective of whether the occupier contributed to the contamination. Lenders are loathe to implicate themselves in sharing any of this potential liability for clean-up and more and more are refusing to lend developers funds to develop on lands where there is any registration of contamination on the property title.

Certain "clean-up" technologies do not actually remove the contamination but leave it somehow immobilized such as through encapsulation, fixation, vitrification or containment. When contaminated soils are "cleaned" in these ways, and the "cleaned" soil remains on the property, our Ministry of the Environment requires that "cleaned" soil to be registered on the property title. The rationale is that the contaminants have not been removed and so they may, at some future date however distant, be released back into the environment and so they still represent an environmental risk. When lawyers and others do title searches on properties and find there is contaminated soil registered on the title, more and more often they are advising the lending institutions and developers not to invest in developing on these lands for fear of accepting some of the liability for clean-up in the event that clean-up is ordered by a regulatory authority.

This concern for cleaning contaminated lands so that there is no registration of residual contamination on the property title and hence no environmental liability to a lender or developer has quickly become the main force encouraging real clean-up of contaminated lands, especially those lands with a potentially high market value, as is the case with the industrial lands in the Port of Toronto.

Another non-regulatory factor influencing clean-up is the public perception that certain technologies are unacceptable irrespective of whether those technologies can "clean" or "treat" contaminated soils such that the cleaned or treated soils satisfy the MOE decommissioning guidelines. Use of thermal technologies, for example, is often unacceptable to the public regardless of whether scientific and operating data can be provided to show that such technologies are effective and relatively harmless to the environment.

Also, the inability to accurately define precisely what soil is contaminated and what soil is not, and the difficulty in physically separating the contaminated soil from the uncontaminated soil so that only contaminated soil is subjected to clean-up can influence the ultimate cost of clean-up.

1.6 Effects of Migrating Contamination

Some contaminants, such as heavy metals in many cases, are not mobile, that is, they are not leached into the groundwater and do not move vertically or horizontally through the soil. Isolated land areas containing non-migrating contaminants can be remediated without a lot of concern for adjacent properties, as long as the clean-up is carried out properly.

However, where contaminants leach into the groundwater and move vertically and/or horizontally through the soil, and where these contaminants migrate across property boundaries, clean-up of one property may be threatened with recontamination from an adjacent property. It is generally very expensive to isolate one cleaned-up property from adjacent contaminated properties, and it is more cost effective to consider clean-up of the whole area affected by migrating contaminants and to deal with it as a single contaminated site. In such an event one would likely want to divert clean groundwater from entering the contaminated site during clean-up and clean up the contaminated soil and contaminated groundwater within the site in a co-ordinated clean-up programme.

1.7 Technology Selection for Site Clean-Up

When we set out to solve the problem of how to effectively clean up the contaminated lands in the Port Industrial District of the Port of Toronto we made several significant decisions that affected our selection of technologies:

(i) our intention was to satisfy regulatory requirements and not to argue or dispute them or try to win special dispensation to do less than the existing guidelines and regulations suggest is appropriate.

(ii) it was also our intention to satisfy the community concern that thermal processes are inappropriate technologies for any use in the Port area. As a result, we rejected thermal processes as potential soil treatment technologies to clean up Port lands.

(iii) we wanted to comply with the predominant community attitude that we should do our site clean-up within our own property boundaries, that we should not send contaminated material off-site for treatment or disposal, and that all of our clean-up activity should be completed within our own backyard.

(iv) we recognized the growing concern among lenders and insurers regarding liabilities of developers of facilities on contaminated lands, so we limited our search to technologies that would clean the contaminated soils such that there would be no registration of contamination on the property title and hence no real or perceived environmental liability for a developer.

2. SOIL REMEDIATION

- **What Does It Mean?**

Soil remediation refers to the clean-up of contaminated land. Until recently, clean-up of contaminated land was normally accomplished by excavating the contaminated soil and disposing of it in a licensed landfill, and backfilling the excavation with clean fill. The result was to move the contaminated soil from one location to another without having the effect of actually removing the contamination problem. In other circumstances, the contaminated soil would be isolated on site or built over, possibly covered with concrete slabs or structures or with asphalt pavement.

Today, in the Metropolitan Toronto area, the tipping fees at the licensed landfills are set at $150 per metric tonne of municipal waste, and may be double that amount for special wastes such as contaminated soil. In some cases, such as soil contaminated with toxic heavy metals, the landfills refuse to accept the material at any price. The only disposal facility that will accept hazardous wastes is the Tricil facility near Sarnia, Ontario, and the cost to haul material there from Toronto and dispose of it is in the order of $700 per tonne.

There are less costly ways of remediating contaminated land than to excavate the contaminated soil and dispose of it in licensed landfills. The problem, however, is that the regulatory authorities are loathe to accept these alternative techniques because they do not yet understand whether these techniques are sufficiently effective in removing or stabilizing contaminants and in producing a relatively clean soil for reuse.

- **Why Do It?**

In the Metropolitan Toronto area, the guidelines that dictate what levels of contaminants such as lead, mercury, oil and grease, etc., are acceptable in a "clean" soil for uses such as residential, parkland, commercial or industrial activity, are set by the Ministry of the Environment (MOE) of the Province of Ontario. However, the municipalities such as the City of Toronto turn these MOE guidelines into regulations by requiring that soils with levels of contaminants in excess of MOE's guideline levels be remediated before development or building permits will be granted. So, if you want to redevelop a piece of contaminated land you must remediate the soil before you'll be granted a development or building permit that will allow you to proceed.

Furthermore, if you are borrowing money to finance development on your own land or on leased land, lenders will require that the property title be unencumbered, that is, that there is no registration of contaminated soil on the property. If one wants "clean" title one must therefore remove any contaminants from the soil and remove those contaminants from the property.

- **How Do You Do It?**

The usual ways of remediating sites in the past were to either pave over the contaminated areas and isolate the contaminants on-site, or to excavate the contaminated soils and dispose of them in licensed landfills. Nowadays, the MOE is loathe to approve containing contaminants on-site, and the cost of disposing contaminated soils at landfills has skyrocketed, with a result that either an economically viable and environmentally acceptable solution has to be found or contaminated lands will rest vacant and unused while development takes place elsewhere.

There are technological ways of remediating soils. Some techniques involve using heat to drive off organic contaminants where the organics are then either burned or are recovered by condensation for re-use. Some techniques utilize bacteria to digest organic contaminants, through landfarming or in large tanks or reactors. Another technique is to wash the soil, either with water or solvents of some kind, to remove the contaminants. Removing metals from soil has been more of a problem, but today there are methods that use mild acids to dissolve the metals and then extract the metals from the acids by chelation and electrolysis. Still other techniques involve encapsulating the contaminants within silica shells formed by adding special chemical compounds to the contaminated soils, where the result is a sandy material like a beach sand with the contaminated particles encased within the sand particles. Yet other technologies produce a sort of aggregate out of the contaminated soil, using cementing agents to stabilize the contaminants so they are immobilized. Some sophisticated techniques use high energy inputs to vitrify the contaminated soil, converting it into a stable glass-like material.

Many of these techniques have already been demonstrated on an experimental basis, especially as part of the United States Environmental Protection Agency's Superfund Sites technology research and development program.

There are some problems related to almost all of these techniques. For one thing, they are all expensive to apply, and some are outrageously expensive and are only used when there is no alternative and cost is not the controlling factor. Secondly, our regulatory authorities have not approved these technologies for use within their jurisdictions; they are not familiar with them and are reluctant to approve their use without locally-obtained hard data on their results. Thirdly, some of the techniques are still only experimental, and their viability needs to be proven through large scale testing and demonstration.

The bottom line is that our regulatory authorities have only felt comfortable approving the technique of excavating contaminated soil and disposing of it in licensed landfills, and they have some self-training to do to become comfortable with accepting alternative site remediation techniques.

- **How Much Does It Cost?**

In the Port of Toronto we would expect to pay at least $200 per metric tonne to excavate a tonne of contaminated soil, haul it and dispose of it in a licensed landfill, and replace it with clean fill, assuming landfill was an option available to us.

Other site remediation techniques have different costs associated with them. If landfarming is sufficient as a remediation technique for reducing levels of organic contaminants, it can often be conducted for costs ranging from $30-$50 per tonne of contaminated soil treated. At the other end of the scale, plasma arc techniques that vitrify soil material into stable glass-like material may cost in the $600-$800 per tonne range.

However you look at it, site remediation is costly. Because it is costly, it behooves the regulatory authorities to respect the value of scare capital and to ensure that their requirements for site remediation are well founded.

- **Can You Afford It?**

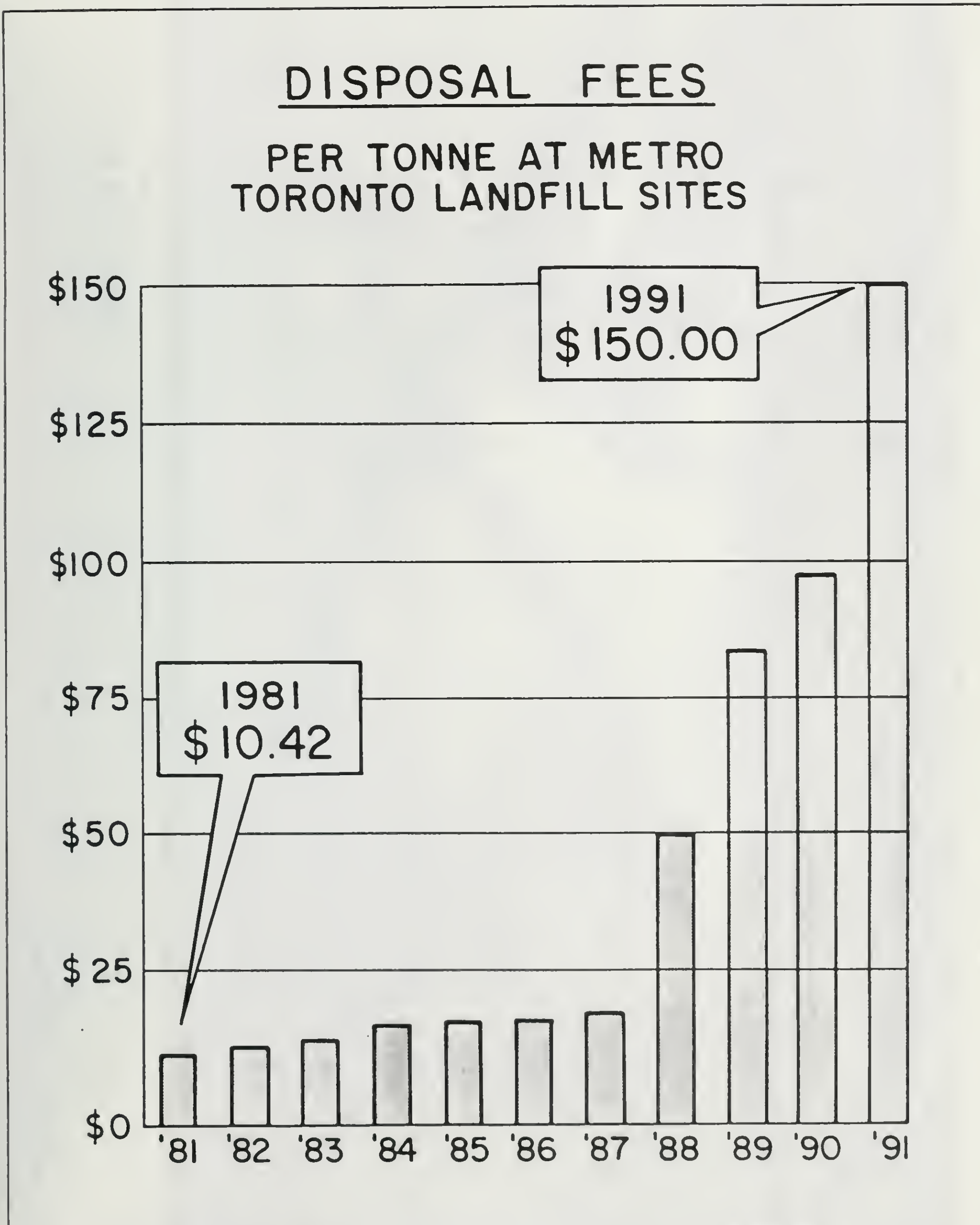
Whether you can afford to clean up your contaminated sites will depend on various things such as the market value of your property (if you are interested or able to sell it), or whether you can recover the costs through increased rents or more highly valued use of the land once it is clean, or whether the regulatory authorities require that you clean it up. And, if you can't redevelop anything on the land until it is cleaned, you have to consider whether you can afford not to clean it up. If clean-up of the land generates new jobs through redevelopment perhaps some of that benefit can be applied to offset the clean-up cost and make the clean-up affordable.

3. A CASE STUDY OF SOIL REMEDIATION: The Toronto Harbour Commissioners' Soil Recycling Demonstration Project

- **Background**

Figure 1 on the following page shows what the Port of Toronto looked like in 1793, when the first survey of the Town of York was completed.

Figure 2 on the next page shows what the Port area looks like today, with the Toronto Islands area having been expanded by some 600 acres, the Port Industrial District on the right having been completed by lakefilling from about 1912 to 1930 adding some 1,000 acres of industrial land where the Ashbridges Bay bog existed in 1911, and the extension of the shoreline southward into the lake to produce the Toronto waterfront as we know it today.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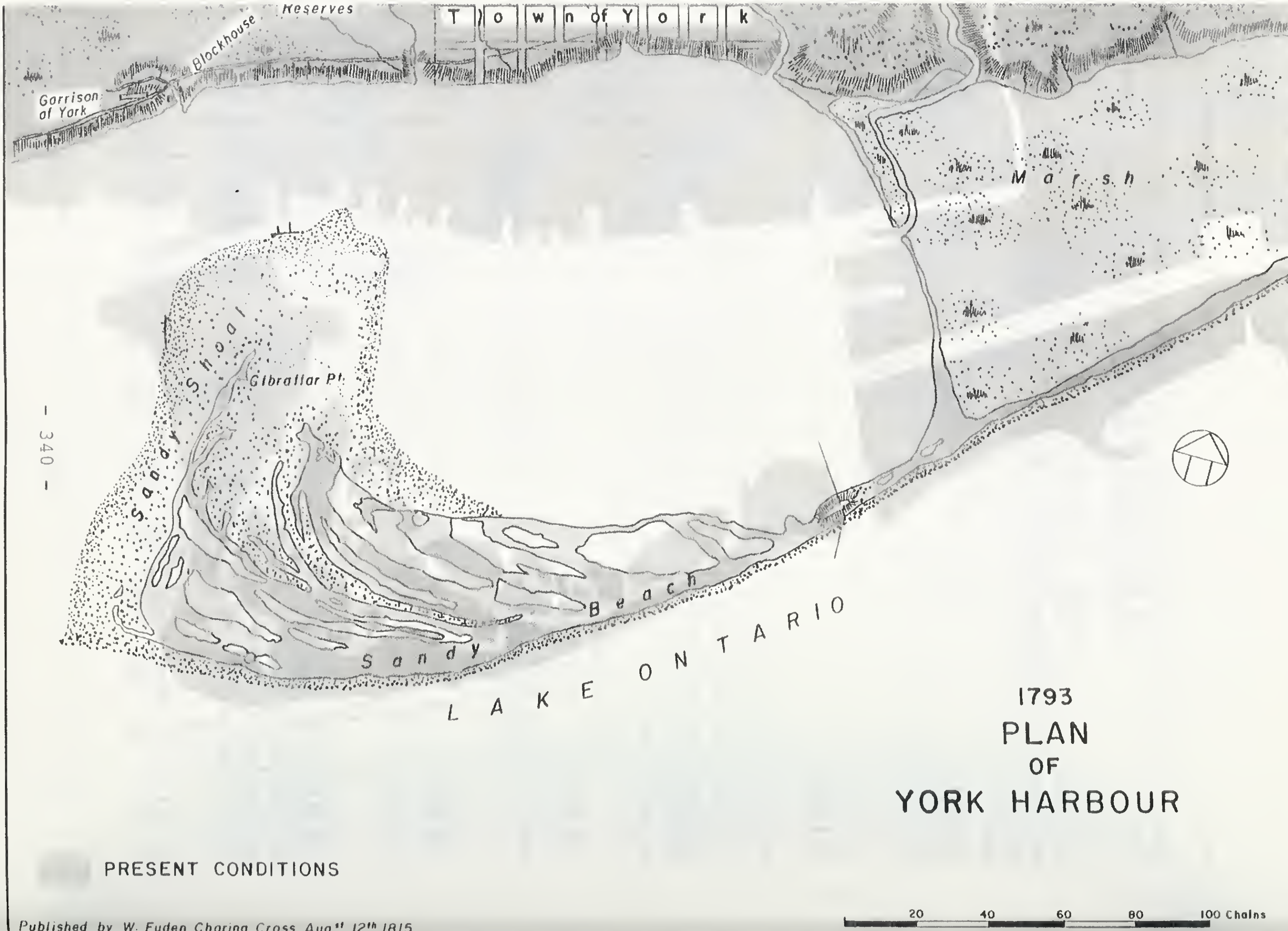
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Town of York
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Gibraltar Pt.
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1793
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OF
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PRESENT CONDITIONS
20 40 60 80 100 Chains
Published by W. Fuden Charing Cross Augst 12th 1815


LAKE ONTARIO

Figure 3 on the following page merely shows a blow-up of the Port Industrial District (PID), which is the area we intend to clean up following a successful demonstration of technologies we propose to use to clean the contaminated soils in the PID.

The Port Industrial District (PID) lands were created by filling with dredged sediments from the inner harbour, and backfilling with soil and rubble and sometimes waste materials such as construction debris and ash. The coarser backfill material is the material within the top 1 - 2 metres, with the dredged sandy silty sediments below.

The PID has always been an industrial area from its creation in the 1912-1930 period. Large tracts of land have changed uses from iron foundry and shell casings manufacturing to oil refining, fuel storage and bulk coal handling, and, more recently, to use by scrap yards and metals recycling industries, bulk salt storage for use on Metro roads, and aggregate handling and batching of concrete. Past industrial uses, while socially and environmentally acceptable in their day, left a legacy of oil and grease contamination combined with a mixture of toxic heavy metals and, in some locations, salt, arsenic and the residue of dyes used in different processes. Some of those contaminants we know today can be carcinogenic in small quantities. Others produce other kinds of health problems, especially if ingested by small children. Yet other contaminants affect plant growth or are simply aesthetically displeasing.

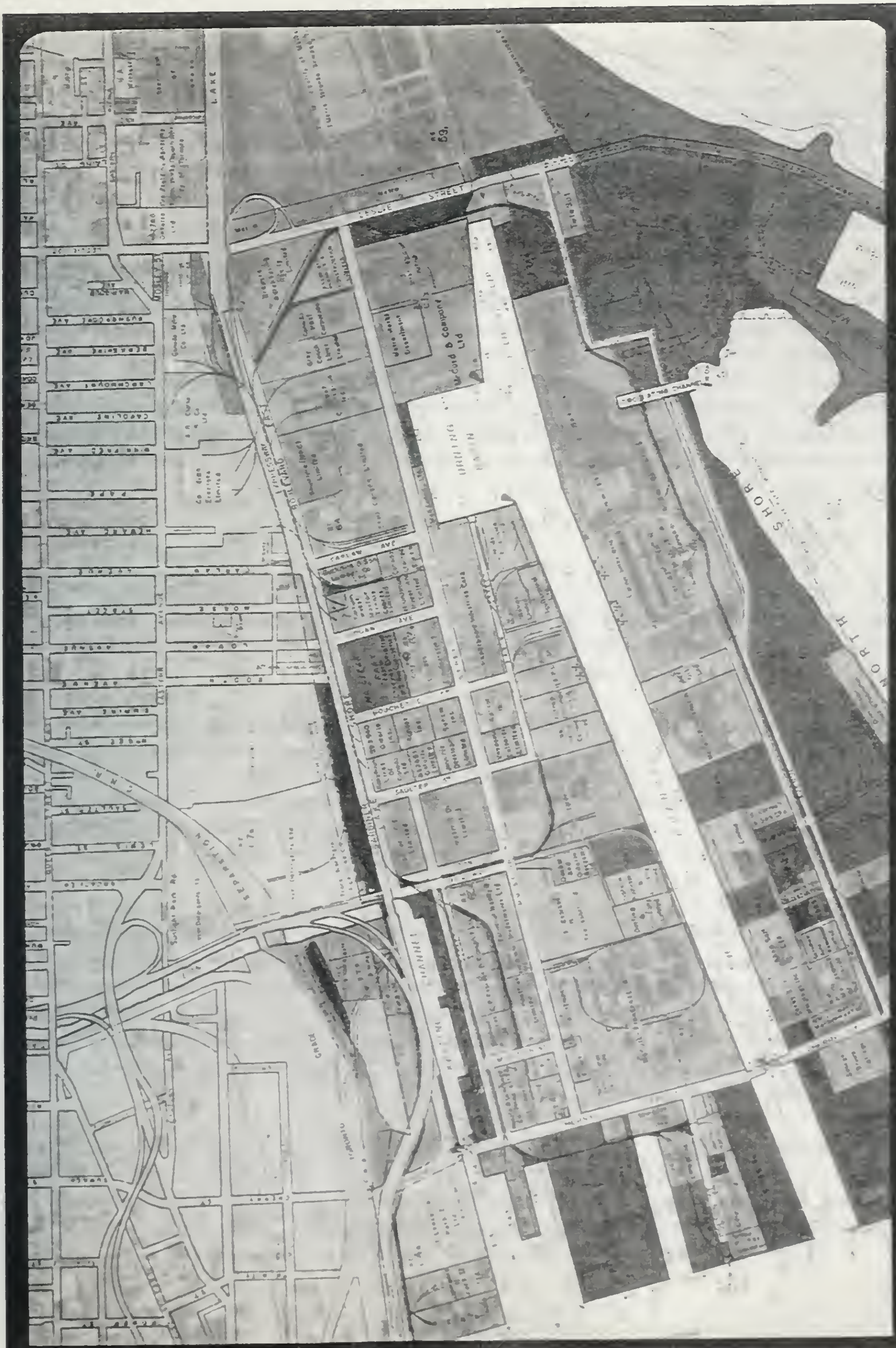
Much of the land has been used, reused and sometimes abused. In some circumstances the lands were probably created using contaminated soils and materials we now consider to be contaminants. Most of the industries that contaminated the lands have long disappeared from the Port area. A few, in particular the oil companies and bulk salt handlers, remain. As in the case of the oil companies, some of the heavy industries are anxious to relocate to other areas where their operations are more appropriately sited.

However, before the existing industries can leave they have to clean up any contamination they've caused on the lands they've leased from us. Before we can re-lease any of the vacated lands, those lands that are contaminated must be cleaned and must meet the current regulatory requirements. The problem, we discovered, is that landfilling the contaminated soil is prohibitively expensive and there is presently no alternative clean-up technique that our regulatory agencies will approve.

We felt we couldn't afford to wait and depend on someone else to find an affordable and acceptable technique to clean up our contaminated lands, so we set out to find our own solution.

- **Current Situation**

The current situation is one where most of our industrial lands are leased. Some of the leased lands are contaminated. Some of our lessees would like to terminate their leases because they want to relocate or are not using all the land they lease. We won't let them



McCord & Company Ltd
NORTH SHORE

out of their leases until they clean up the contamination they've caused. With no affordable clean-up technique available to them, they renew or overhold their leases, and, although they pay their rents, the lands sit idle. The casual observer is likely to conclude that the lands are vacant - they are not vacant, but are merely underutilized and will remain so until an affordable and acceptable (to the regulatory agencies and to us) means of remediating the contaminated soils is found.

The land holdings, operations and mandate of The Toronto Harbour Commissioners is the subject of a Royal Commission on the Future of the Toronto Waterfront, headed by the Honourable David Crombie. That Commission has conducted its own audit and review of the Port lands. It also, I believe, has come to realize that the lack of an affordable approved technique for remediating the contaminated lands is what is stopping The Toronto Harbour Commissioners (and would equally be stopping anyone else if they owned those lands) from redeveloping the Port Industrial District lands to achieve their full potential to support new clean green industry and create numerous jobs for residents within the Metropolitan Toronto area.

- **Clean-Up Objectives**

The Ontario Ministry of the Environment has established clean-up guidelines for soils. The guidelines were developed to set out the acceptable limits of various contaminants in soils based on potential adverse affects on human health, plant health (phototoxicology), the health of grazing animals, and aesthetic reasons.

The following three tables set out the MOE guidelines for contaminated soils as of March, 1992. Table 1 shows the established guidelines for 18 parameters, most of them being heavy metals. Table 2 shows provisional guidelines for an additional four parameters. Table 3 shows the interim guidelines for 43 organic contaminants - these were developed as site-specific criteria for clean-up at the Shell Oakville and Texaco Port Credit refineries and are applied generally as the MOE's interim organic contaminants guidelines.

In addition, Ontario Regulation 11/82 defines soils containing greater than 50 parts per million (ppm) of PCBs as PCB waste which must be properly stored until an approved disposal method is found. Ontario Regulation 309 under the Environmental Protection Act describes the test procedure used to determine whether a soil is a "registerable waste" or a "hazardous waste". Registerable wastes may be accepted at licensed sanitary landfills, whereas hazardous wastes can only be accepted at the hazardous waste disposal facility operated by Tricil near Sarnia, Ontario. Also, if dioxins or furans are detected in soils those soils are immediately classified as hazardous waste.

Looking at Tablė 3 you will see mention of "clean-up" levels and "trigger" levels. Soils that do not meet clean-up levels require remedial action, whereas trigger levels merely indicate a warning level and suggest that if these levels are exceeded further consideration is warranted to determine whether remedial action is necessary.

TABLE 1 CLEAN-UP GUIDELINES FOR SOILS

	CRITERIA FOR PROPOSED LAND USE½			
	AGRICULTURE/RESIDENTIAL/PARKLAND [4]		COMMERCIAL/INDUSTRIAL	
Parameter [2]	Medium & Fine Textured Soils	Coarse Textured Soils [5]	Medium & Fine Textured Soils	Coarse Textured Soils [5]
pH (recommended range)	6-8	6-8	6-8	6-8
EC (mS/cm) [7]	2	2	4	4
SAR [8]	5	5	12	12
Arsenic	25	20	50	40
Cadmium	4 [1a]	3 [1a]	8 [1a]	6 [1a]
Chromium (VI)	10	8	10	8
Chromium (Total)	1000	750	1000	750
Cobalt	50	40	100	80
Copper	200 [1b]	150 [1b]	300	225
Lead	500 [1a]	375 [1a]	1000 [1a]	750 [1a]
Mercury	1 [1a]	0.8 [1a]	2 [1a]	1.5 [1a]
Molybdenum	5 [1b]	5 [1b]	40	40
Nickel	200	150	200	150
Nitrogen (%)	0.5 [9]	0.5 [9]	0.6 [9]	0.6 [9]
Oil and Grease (%)	1 [6]	1 [6]	1 [6]	1 [6]
Selenium	2 [1b]	2 [1b]	10	10
Silver	25	20	50	40
Zinc	800	600	800	600

otes:

Clean-up guidelines recommended by the Phytotoxicology Section, Air Resources Branch, MOE. The guidelines are based primarily on phytotoxicology except for (1a) based on human health, and (1b) based on health of grazing animals.

All units are in ppm (ug/g), dry weight, unless otherwise stated.

For comparison with these guidelines, analyses for metal and metalloids must be conducted using an approved strong, mixed-acid digestion procedure. Contact the Laboratory Services Branch of the MOE if in doubt about acceptable methods.

Guidelines have been endorsed by the OMAF/MOE/MOH Sludge Utilization Committee.

Defined as greater than 70% sand and less than 17% organic matter.

Guideline given is for fresh oil; for weathered oil (min. 2 yr. exposed on site), the guideline is 2%.

EC = electrical conductivity (saturation extract).

SAR = sodium adsorption ratio.

If nitrogen levels exceed the guidelines, the mineralization of the soils should be evaluated. Additions of nitrogen-based fertilizer may be counterproductive.

TABLE 2 PROVISIONAL CLEAN-UP GUIDELINES FOR SOILS

	CRITERIA FOR PROPOSED LAND USE [1/3/4]			
	AGRICULTURE/RESIDENTIAL/PARKLAND		COMMERCIAL/INDUSTRIAL	
Parameter [2]	Medium & Fine Textured Soils	Coarse Textured Soils [5]	Medium & Fine Textured Soils	Coarse Textured Soils [5]
Antimony	25	20	50	40
Barium	1000	750	2000	1500
Berylium	5	4	10	8
Vanadium	250	200	250	200

Notes:

1 These guidelines are tentative: actual permissible levels of parameters in othe situations may vary according to site specific circumstances. Further information on th application of these guidelines may be obtained from the Phytotoxicology Section of Ai Resources Branch, Ministry of the Environment.
2 All units are in ppm (ug/g), dry weight.
3 For comparison with these guidelines, analyses must be conducted using an approved strong mixed-acid digestion procedure. Contact the Laboratory Services of the MOE if in doub about acceptable methods.
4 These provisional guidelines apply to soil of minimum pH 6.
5 Defined as greater than 70% sand and less than 17% organic matter.

ABLE 3 U.S. EPA AND MOE LIST OF ORGANIC COMPOUNDS IN PETROLEUM REFINING WASTE

CRITERIA COMPOUND	PROPOSED RESIDENTIAL/ CLEAN-UP CRITERIA OR TRIGGER LEVEL () (April 1988) ppm	PROPOSED INDUSTRIAL COMMERCIAL CLEAN-UP OR TRIGGER LEVEL () (April 1988) ppm
Monocyclic Aromatics		
1. Benzene	1.6	3.2
2. Toluene	(1.6)	(3.2)
3. Xylene	10	20
4. Ethylbenzene	(1.6)	(3.2)
5. Styrene	(1.6)	(3.2)
Polycyclic Aromatics		
6. Indene	not set	not set
7. Naphthalene	(4.0)	(8.0)
8. 1-Methylnaphthalene	(4.0)	(8.0)
9. Anthracene	(6.0)	(12.0)
10. Phenanthrene	(14)	(28)
11. Benzo(a)anthracene	7.9	15.8
12. 7,12-DMBA	0.4	0.8
13. Chrysene	(14)	(28)
14a Total methyl chrysenes	(4.0)	(8.0)
14b 5-Methyl chrysene	(1.2)	(2.4)
15. Pyrene	(24)	(48)
16. Fluoranthene	(15)	(30)
17. Dibenz(a,h)anthracene	0.9	1.8
18. Benzo(a) pyrene	1.2	2.4
19. Benzo(b) fluoranthene	(1.2)	(2.4)
20. Benzo (k) fluoranthene	6.6	13.2
Phenolics		
21. Dibenz(a,h)acridine	not set	not set
22. 2,4-dinitrophenol	not set	not set
23. Phenol	not set	not set
24. Cresols	not set	not set
25. 2,4-dimethylphenol	not set	not set
26. 4-nitrophenol	(4.0)	(8.0)
Phthalate Esters		
27. Dimethyl phthalate	(4.0)	(8.0)
28. Diethyl phthalate	(4.0)	(8.0)
29. Di(n)butyl phthalate	(10)	(20)
30. Di(n)octyl phthalate	(15)	(30)
31. DEHP (bis-2-EHP)	(67)	(134)
32. Butyl benzyl phthalate	not set	not set
Halogenated Aliphatics		
33. Chloroform	(1.6)	(3.2)
34. 1,2-dichloroethane	not set	not set
35. Ethylene dibromide	not set	not set
Halogenated Cyclics		
36. Chlorobenzene	(1.6)	(3.2)
37. Dichlorobenzenes	not set	not set
Miscellaneous		
38. Benzenthiol	not set	not set
39. Carbon disulfide	(8.8)	(17.6)
40. 1,4-dioxane	(4.0)	(8.0)
41. Methyl ethyl ketone	50.0	(100)
42. Pyridine	not set	not set
43. Quinolines	not set	not set

The criteria in Tables 1, 2 and 3 apply to clean-up of land for redevelopment. Table 4 shows the MOE guidelines for dredged spoil for open water disposal. There is no active programme for the clean-up of contaminated sediments as yet in Ontario, but if and when there is these could become the clean-up criteria for contaminated sediments.

- **Feasibility Study**

During 1990 The Toronto Harbour Commissioners appropriated $60,000 to have the Director of Engineering carry out a feasibility study to determine whether it was feasible to implement a full scale clean-up of the contaminated lands in the Port Industrial District. To assist me in carrying out this feasibility study I obtained the services of Dr. Diana Mourato from SNC Inc. out of Montreal. Dr. Mourato had been closely involved with the work at the Port Credit refinery that resulted in the setting of the 43 interim organic contaminants guidelines previously mentioned in Table 3. She had already done considerable research on solvent extraction and bioremediation techniques and was familiar with most of the state-of-the-art technologies and emerging technologies for remediating contaminated soils. She also had a working knowledge of the MOE regulatory system and the approvals process for conducting demonstration scale tests of new technological processes for remediating contaminated soils.

The study examined the types of soils in the PID, the available data on the types and levels of contaminants that existed in the PID soils and groundwater, and the various existing technologies that were available to remediate our contaminated soils and groundwater.

The technology search began with a search through available literature. We also made some key assumptions that eliminated many technologies, namely

(1) that the use of thermal technologies in the PID would be politically unacceptable and was a non-starter since we could never obtain regulatory approval for such a technique even if technically it could be shown to meet environmental regulations and requirements.

(2) that encapsulation and fixation technologies were also unacceptable. The MOE requires that, even if a contaminant is encapsulated and rendered immobile and even if after encapsulation tests on the soil no longer detect the presence of the contaminants, since the contaminant is still there and the MOE know it is there and the MOE doesn't know how long the contaminant will remain immobilized, the contamination must be registered on the property title. The consequence of this registration on title is that a lender or insurer of a proposed development views the registration on title as a potential liability and the property becomes more difficult, perhaps impossible, to develop. We wanted all of our leasable lands to have unencumbered title, with no environmental liabilities associated with their lease, in order to obtain best use and best revenue for the rented use of those lands.

TABLE 4 MOE GUIDELINES FOR DREDGE SPOIL FOR OPEN-WATER DISPOSAL (Addendum 1978)

PARAMETER EVALUATED	MAXIMUM LIMITS
Volatile Solids	6% (60,000 ppm)
Chemical Oxygen Demand (C.O.D.)	5% (50,000 ppm)
Total Kjeldahl Nitrogen (TKN)	0.2% (2,000 ppm)
Oil and Grease	0.15% (1,500 ppm)
PCBs	0.05 ppm
Mercury (Hg)	0.3 ppm
Lead (Pb)	50 ppm
Copper (Cu)	25 ppm
Zinc (Zn)	100 ppm
Chromium (Cr)	25 ppm
Nickel (Ni)	25 ppm
Iron (Fe)	10,000 ppm or 1%
Arsenic	8.0 ppm
Cadmium	1.0 ppm
Cyanide	0.1 ppm
Ammonia	100 ppm
Cobalt	50 ppm
Total Phosphorus (P)	0.1%

Other objectives we set were to use existing commercially available technologies wherever possible, and to use technologies that optimized recycling and reuse of the soil and the contaminants removed from the soil. We also wanted to be able to remediate our soils for a cost of less than $200 per tonne which is our current cost for excavating contaminated soil and disposing of it in a licensed landfill and replacing it with clean fill.

Very quickly our investigations led us to look at technologies that cleaned contaminants from soil. Soil washing was seen as a viable technology whereas solvent extraction, which washes the soil with solvents, was considered too expensive. Once we selected soil washing as a means of cleaning the contaminants from the bulk of the soil and producing a slurry containing the large majority of the contaminants, we then had to find technologies that would remove metals and organic contaminants from a slurry.

We concluded that the most acceptable and affordable system for removing our types of contaminants from our types of soils on a large scale was to integrate three technologies in series, that is, to construct a soil cleaning facility with three technologies or cleaning processes. The processes we selected were first, soil washing, followed by metals removal by chelation, followed by organics reduction by biological activity in controlled reactors.

The net result would be:

- about 80% of the soil would be cleaned and suitable for reuse as backfill on industrial land following the soil washing process.

- the soil washing would also remove large metal particles by magnetic separation, free oil by skimming, and lighter contaminant fractions such as coal particles and peat by gravity separation.

- following soil washing, contaminants would be confined to a slurry stream containing approximately 20% (by weight) of the bulk soil, with a maximum particle size of less than 100 microns in diameter.

- the contaminated slurry would pass through a reactor designed to remove inorganics (heavy and light metals) by chelation. At the end of this process metals would either be precipitated or removed by electrowinning so that the metals would be removed in elemental form, stable and available for recycling as a raw product in some metal processing industry.

- the remaining slurry containing organic contaminants would be fed into large reactors (tanks with pumps and equipment to provide air and stir the slurry) where naturally occurring bacteria would attack the organic contaminants and digest them to levels below the acceptable levels for those organic contaminants in industrial soils.

- the cleaned slurry would then be dried using cyclones and the dried fines combined with the cleaned sand from the soil washing process and returned to the excavation site as clean backfill.

- the soil washing plant would be equipped with a water treatment plant to remove contaminants from the process water using conventional water treatment systems.

- a full scale facility that would clean 50 tonnes of contaminated soil per hour would cost in the range of $20-$25 million to construct and would clean contaminated soil at a cost in the order of $160 per tonne.

The feasibility study recommended that we implement a Soil Recycling Demonstration Project to demonstrate our selected technologies at a large enough scale to show the regulatory authorities and the general public what a full scale facility would be like, to obtain factual operational data on the efficiency of each technology to meet MOE clean-up criteria, and to refine what the actual full-scale plant operating costs would be in order to decide whether to proceed to full scale clean-up using these technologies in a plant to be owned and operated by The Toronto Harbour Commissioners.

The feasibility study recommendations were presented to our Board at its regular meeting in December, 1990, and at that meeting the Board authorized me to proceed with implementing a Soil Recycling Demonstration Project with funding of up to $4.3 million from The Toronto Harbour Commissioners.

The Board also authorized me to make application to Environment Canada's orphan sites technology research and development programme (the DESRT funding programme) for partial funding, however, the $4.3 million appropriated by the Board was to be sufficient to fund the entire project should DESRT funding not be forthcoming. We filed an application for DESRT funding and were rejected on the basis that we could obviously fund the demonstration plant without assistance, and yet DESRT funding is only granted if the proponent can afford to implement full scale clean-up.

- **Soil Recycling Demonstration Project**

In January, 1991, we held a press conference to announce we were proceeding with our Soil Recycling Demonstration Project. We hired SNC Inc., with Dr. Diana Mourato as Project Manager, to help us design and operate a demonstration facility to test the technologies. SNC was providing some of the technologies which were being scaled up from laboratory scale to pilot/demonstration scale for the first time, and invested some of its own funds in acquiring and upscaling these technologies for demonstration in our facility.

We decided we would treat three samples of contaminated soils; one sample contaminated with mostly heavy metals, one with mostly oil and grease, and one with metals and organics all together.

We also decided we would test the effectiveness of two different soil washing techniques, one where no chemicals are added and high pressure water jets are used to clean contaminants off and separate them from soil particles, and another where agitation and scrubbing with detergents and surfactants are used to clean the soil. To test the high pressure wash system we had to ship 350 tonnes of each of three samples to a wash plant in Weert, Holland, where the washed soil and contaminated slurry have been shipped back to us for further processing through our heavy metals and biological treatment processes in Toronto. To test the attrition scrubbing soil washing process we were able to lease a pilot scale mobile unit from Bergmann USA out of Stafford Springs, Connecticut. This is the first wash plant Bergmann built in its USA plant, although their European parent has built about 25 similar plants at its factory in the Netherlands.

The heavy metals extraction unit was built by DeVoe Laboratories in Palm Springs, California. The bioslurry reactors were built by SNC Inc. on site in Toronto.

Figure 4 on the following page shows the site plan for our Soil Recycling Demonstration Project. The site is 5.8 acres in size, and is totally paved and secured. Water is collected in lined ponds for use as make-up water in the soil washing process. Once the test is completed all facilities will be removed from the site. The process plant area and the contaminated soil storage area are enclosed by leased buildings. We will have office trailers, a mobile lab and a reception trailer for conducting tours.

We will process about 1350 tonnes of each of three samples of contaminated soil through this demonstration facility. We may process a sample of contaminated sediment, and we will be processing a sample of soil from the City of Toronto's proposed Ataratiri housing project area and at least one other sample of contaminated soil from the Port area.

Table 5 on the following page shows the approximate range of contaminants (of the contaminants listed in the MOE guidelines in Table 1) present in each of our three Port area samples A, B and C. Table 6 on the next page shows the approximate range of the other organic contaminants (from Table 2) in each of our samples.

Our objective is to reduce the level of these contaminants in our soils to below the MOE guideline levels.

- **Approvals**

We submitted an Initial Environmental Assessment to the Federal Environmental Assessment Review Process for consideration, and received some useful comments in return.

We had to apply for and obtain a Certificate of Approval (Air) from the Ontario Ministry of the Environment. We applied on April 5, 1991, and received our fast track approval on July 9, 1991.

PROPOSED SOIL RECYCLING
DEMONSTRATION PLANT
SITE PLAN

TABLE 5 CONTAMINANT DATA FOR SAMPLES A, B, AND C

SAMPLE	B	C	A	MOE Criteria
PARAMETER				
Arsenic	40 - 54.5	-	0 - 340	40
Cadmium	6 - 9	-	6 - 25	6
Copper	-	225 - 1150	225 - 1260	225
Lead	600 - 17800	600 - 996	600 - 2000	750
Mercury	1.5 - 2.6	-	1.5 - 2	1.5
Nickel	-	-	150 - 480	150
Oil and Grease	0.7% - 10.5%	0.7% - 5.1%	0.7% - 1.94%	1%
Zinc	600 - 851	600 - 1180	600 - 6400	600

Note:

(1) All concentrations are in ppm.

(2) All above data has been extracted from Consultants' reports.

TABLE 6 ORGANIC DATA FOR SAMPLES A, B AND C

COMPOUND	SAMPLE B	SAMPLE C	SAMPLE A	MOE CRITERIA
PAH				
Naphtalene	0.16-25	0.2-1.5	4.1	[8.0]
Acenaphtalene	0.011-1.3	0.1-1.3	2.3	
Acenaphtene	<0.01-2.3	ND-3.4	3.1	
Fluorene	<0.01-6.4	0.1-4.3	6.1	
Phenantrene	0.026-21	0.9-21.0	24	[28.0]
Anthracene	0.011-4.6	0.2-4.1	9.7	[12.0]
Fluoranthene	0.035-7.3	2.1-27.3	24	30
Pyrene	0.034-4.5	2.1-23.8	23	[48]
Benzo(A)Anthracene*		1.2-13.9	11	15.8
Chrysene*	0.06-4.4	1.2-14.3	9	[28]
Benzo(B)Fluoranthene**	0.037-2.6	1.1-15.5	41	[2.4]
Benzo(K)Fluoranthene**		1.7-14.2	1.68	13.2
Benzo(A)Pyrene		1.7-14.6	11	2.4
Indeno(1,2,3-CD)Pyrene	<0.01-0.11	1.2-11.6	<0.1	
Debenzo(A,H)Anthracene	<0.01-0.61	0.7-7.4	<0.1	1.8
Benzo(G,H,I)Perylene	<0.01-0.77	1.9-11.9	5.4	
VOLATILE ORGANICS RESULTS***				
Benzene	0.013-0.25	0.3-0.6		3.2
Toluene	0.015-0.033	0.3-0.5		[3.2]
Ethylbenzene	0.008-0.077	0.6-0.9		[3.2]
M-Zylene & P-Xylene		2.0-2.1		
C-Xylene		0.7-0.8		
Total Xylene	0.047-0.36			20

* Combined Results for Sample B
** Combined Results for Sample B
*** Only Detectable VOC's Are Reported

The MOE waived our requirement for a Part 5 approval relating to the excavation and movement of the samples of contaminated soil from the excavation site to and from our demonstration facility. However, the cleaned soil after it is processed through our plant is still considered waste and will not be declassified to soil.

We received Development Approval from the City of Toronto at its regular Council meeting on July 9, 1991, and a Building Permit followed.

We obtained approval from Agriculture Canada, Environment Canada and Transport Canada to ship our samples of contaminated soils to the wash plant in Holland and to return the washed soil and contaminated slurry to Toronto for further processing.

The wash plant owners in Holland obtained the necessary approvals from the Dutch government to permit our soils samples to enter Holland for processing and to leave Holland, once they were processed, for return to Toronto.

We also obtained plumbing and electrical permits from local authorities to enable us to service our site.

- **Schedule**

Operations at our Soil Recycling Demonstration Project began on January 6, 1992. On January 28, 1992, Her Worship June Rowlands, Mayor of Toronto, officially opened our facility.

We expect to complete our tests during the summer of 1992 and publish our results.

The projected completion cost of our demonstration project has risen to $7 million due to start-up delays, enclosure and heating of facilities, and oversizing of some equipment. The project cost is being shared $5 million by the THC and $2 million by SNC. No public funds are being used to finance the demonstration.

- **Other Tests**

Other technology suppliers have asked that we provide them with small soils samples of our three samples (samples A, B and C) so they can test the effectiveness of their technologies in treating our soils and provide us with results to compare against the results of our own tests. Whenever so requested we have provided others with samples of our soils and encourage other technology suppliers to demonstrate the effectiveness of their clean-up alternatives.

- **Site Tours**

Appended to this paper is a copy of the tour guide distributed to persons who visit our facility. The guide explains our soil cleaning process. Anyone wishing to tour our facility should contact me at (416) 863-2047 to arrange a tour. All inquiries are welcome.

- **Treatment Results**

We are still compiling our test data and expect to publish our test results by the end of July, 1992. Preliminary results are very satisfying and typical results are as follows:

Contaminant	Soil In (ppm)	Soil Out (ppm)	MOE Criteria (ppm) Industrial	Residential
Copper	550	50	225	150
Lead	800	150	750	375
Zinc	1600	40	600	600
Nickel	300	150	150	150
Benzo(a)pyrene	5	<2	2.4	1.2
Oil and Grease	25,000	5,000	10,000	10,000

- **Full Scale Clean-Up**

We anticipate that our tests will demonstrate that our technologies are environmentally acceptable and can clean contaminated soil at an affordable cost, and that at the conclusion of our test we will be recommending implementation of a programme to proceed with total area clean-up.

There are many matters to be resolved before total area clean-up including a soil cleaning facility could be implemented with any reasonable confidence for success. Among the matters to be resolved are:

- what clean-up criteria will be applied over the long term, to ensure that our technologies are not obsolete before the site clean-up is completed.

- a decision as to what depth clean-up is required for complete clean-up and unencumbered title.

- delisting or deregulation of cleaned soil.

- acceptable procedures for identifying and quantifying what soils are contaminated.

- what parties will pay what amounts of the clean-up costs, and overall financing of full-scale clean-up.

- agreements among those responsible for contamination, including the owners of contaminated lands within the PID, for use of our facility to clean their soils and the charges they must pay for that service.

- an acceptable staged implementation schedule, and regulatory agency agreement covering interim use of contaminated lands waiting their turn in the clean-up schedule.

- continued community support for our clean-up programme.

Many of these critical issues depend upon successful resolutions between the THC and the regulatory authorities to set the framework for undertaking the clean-up programme. We have initiated these discussions with the regulatory agencies and encourage their involvement in our Soil Recycling Demonstration Project, to enable us to implement a full scale clean-up programme as quickly as possible.

4. APPENDIX

Tour Guide of our Soil Recycling Demonstration Project.

THE TORONTO HARBOUR COMMISSIONERS

Soil Recycling Demonstration Plant

Soil Recycling Demonstration Plant

Environmental clean-up of waterfront lands are of critical concern to any future development of these properties. The Toronto Harbour Commissioners, in recognition of the immediate need to clean up contaminated soil on their properties, have committed $4.3 million to this state-of-the-art soil cleaning facility. While proposing to clean our lands at no cost to the taxpayer, this project also offers the prospect of diverting enormous quantities of soil from Metro's rapidly diminishing landfill sites.

The Toronto Harbour Commissioners (THC) will operate this state-of-the-art soil recycling plant to demonstrate and test technologies available to clean contaminated soils in the Port Industrial District of Toronto's waterfront. The plant is designed to remove contaminants from soils and permit recycling of the cleaned soils and the contaminants. The lands will then be available for redevelopment by clean, "green" industry.

Site

An entrance sign facing Cherry Street identifies our project.

A small display at the entrance has been erected to explain what the project is about and how one can arrange to tour the facilities.

Our test facility is 5.8 acres in size and has been secured by a chain link fence with an automatic card-reader electric gate.

The plant site has been paved and is divided into two parts, a contaminated soil handling area[1] that drains to a holding pond[2], and a processing or clean area[3] that drains to another holding pond[4]. Another cell[5] has been added as a water storage and make-up pond, to provide raw water to the soil washing plant.

We have a site trailer[6] which is our reception area for starting our tours. Displays in the trailer are placards from the Open House we held on our project at the St. Lawrence Hall on July 10, 1991. In our site trailer guests will be asked to sign the visitors register and receive a hard hat and white coat to wear during the tour. Our trailer and its public washroom are accessible by wheelchair.

Other trailers on-site include a washroom[7], SNC Inc.'s project management trailer[8], an operations trailer at the metals extraction process area, and Bergmann's temporary office trailer.

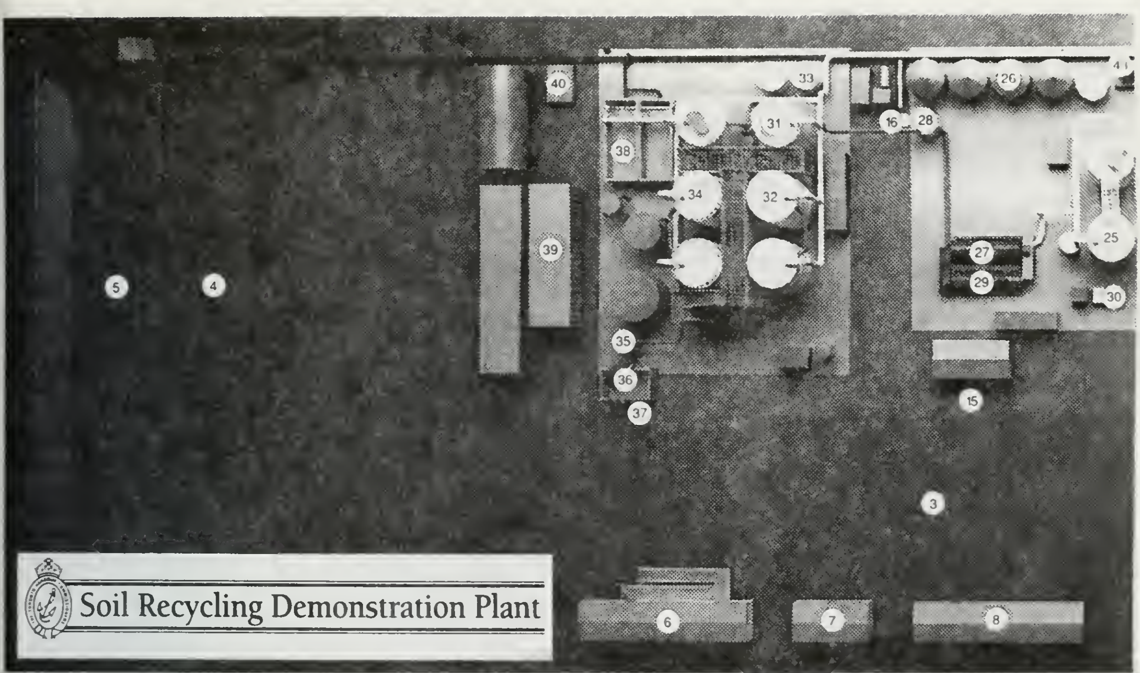
Contaminated Soil Treatment Process

The treatment facilities are enclosed inside a temporary RUBB building[15] that is about 28 metres (90 feet) wide, 61m (200 feet) long, and 12m (38 feet) high. Vehicle access to the building is through 14 ft. by 14 ft. doors at the east and west ends of the building, and through two 12 ft. doors on the south face of the building, in line with the roadways between the three processing areas inside the building. The building is heated to maintain the temperature inside at above freezing.

The Bergmann wash plant is capable of washing 5 to 10 tonnes of bulk contaminated soil per hour, and will be operated for 8 to 10 hours per day, possibly longer, depending on the capability of the rest of the plant to treat the contaminated slurry produced by the wash plant.

Process make-up water will be pumped from the outdoor storage cell[5], through a heat exchanger[16] where steam is pumped around the water supply pipeline to raise the temperature of the supply water to the wash plant to a minimum 55_F. The steam for the heat exchanger is provided by an electric boiler that draws up to 400 amps.

Scrubbed particles from the rotary trommel washer[14] pass over a wet sieve where particles larger than 6mm (1/4 in.) are removed as cleaned soil and collected in a bin[17] for reuse as clean backfill on industrial land. The

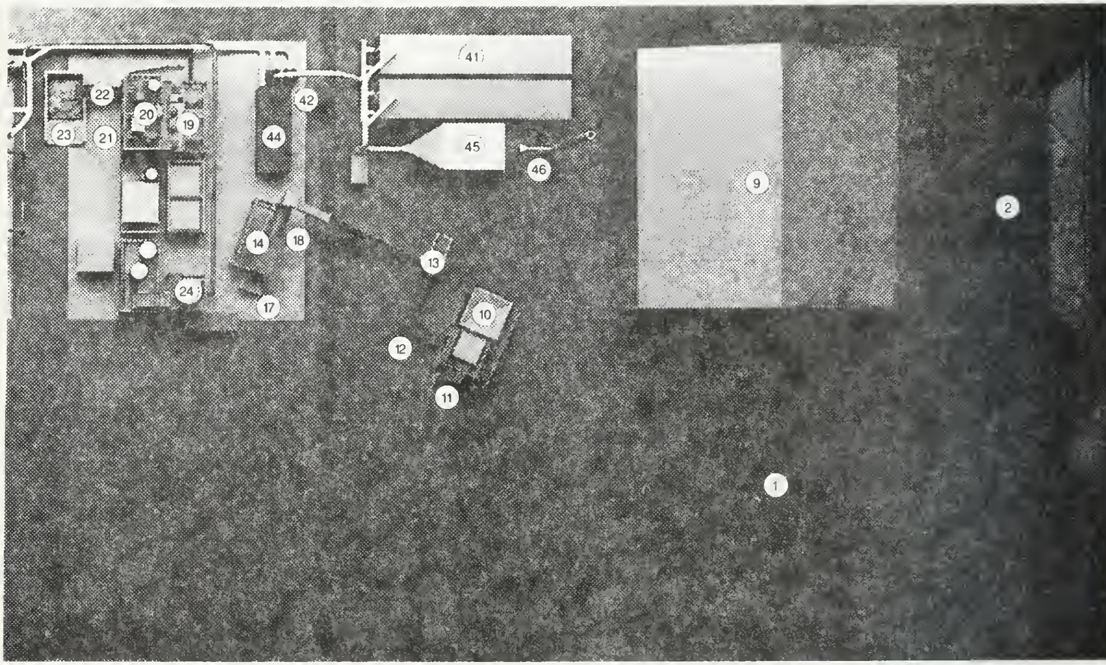


contaminated fines and washwater fall through the screen into a holding tank. There are three oil skimmers[18] on the holding tank to remove any free oil from the water and store it in a 45 gallon drum for recycling. The remaining soil (particles smaller than 6mm) and washwater are pumped to a separation cyclone[20] where the contaminated fines are separated from the coarser soil particles. The fines are pumped to a lamellar separator and on to the gravity thickener[24] while the coarse soil is pumped to the attrition scrubbers[19].

There are three attrition scrubbing cells, where paddles on shafts are used to agitate the soil particles causing them to rub against each other and scrub fine particles of contaminants off the surface of the soil particles. The slurry of soil and washwater is scrubbed in the first cell, is then pumped to the second cell for further scrubbing, then is pumped to the third cell for final scrubbing. Acids may be added, if needed, to one cell to aid in dislodging contaminants from the soil particles or in dissolving certain contaminants, bases may be added in a second cell, and detergents or surfactants may be added in a third cell. These cells are where the washing of soil is completed. From this point on, the wash plant process parts are all equipment used to separate the soil particles (fines) from the washwater and to treat the contaminated washwater so it can be reused in the washing process.

Scrubbed soil particles and washwater are pumped from the attrition scrubbing cells to a second hydrocyclone[20] at the top of the plant. The cyclone is like a centrifuge where particles larger than 63 microns (about 1/400th of an inch in diameter) are separated from the process water and the remaining fines. The coarse soil stream is then passed through a density separator[21] to remove light density materials such as coal and peat particles from the heavier soil particles. The coal and peat are collected separately as a potentially contaminated waste stream, whereas the cleaned coarse soil particles are discharged by conveyor[22] to a collection bin[23]. These clean soils can then be combined with the clean soils collected in the bin[23] after the trommel washer, and can be returned to the excavation site as clean backfill.

Process washwater with contaminated fines smaller than 63 microns in size passes through a lamellar separator to remove fines from the process water. The fines are then pumped to a deep cone sludge thickener[24]. The contaminated slurry that is discharged from the sludge thickener passes to the two holding tanks[25] at the front end of the inorganics removal system. Contaminated process water removed from the lamellar separator and from the sludge thickener passes through a conventional water treatment system within the soil washing plant and is discharged as treated water to the outdoor



Points Of Interest

1 Contaminated soil handling area, paved
2 Holding pond -contaminated surface runoff
3 Clean soil handling area, paved
4 Holding pond - clean surface runoff
5 Holding cell, process washwater
6 Reception trailer
7 Washroom trailer
8 Project administration trailer
9 Contaminated soil storage building
10 Contaminated soil feed hopper
11 Bin collecting oversize (_50mm) particles
12 Conveyor from hopper to wash unit
13 Magnetic separator
14 Trommel wash unit
15 Building enclosing process area
16 Heat exchanger to warm wash water
17 Bin collecting washed coarse (6mm to 50mm) particles
18 Oil skimmers to remove free oil
19 Attrition scrubber units (3)
20 Hydrocyclone to remove intermediate (0.063mm to 6mm) particles
21 Density separator to remove coal and peat particles
22 Discharge conveyor
23 Bin collecting cleaned intermediate sized (0.063 to 6mm) particles
24 Sludge thickener unit
25 Holding/acid contact tanks (2)
26 Acid storage tanks (3)
27 First metals chelation reactor
28 Holding/oxidant mixing tank
29 Second metals chelation reactor
30 Electrowinning unit
31 Surge/feed tanks (2)
32 Upflow bioreactors (3)
33 Nutrients storage tanks (2)
34 Aerobic digester tank
35 Holding tank
36 Dewatering hydrocyclones (3)
37 Bin holding clean fines (smaller than 0.063mm)
38 Flocculation and sedimentation tanks (2)
39 Mobile water treatment unit
40 Air intake units
41 Air biofilters (2)
42 5000 cfm pumps (2)
43 Air/acid scrubber
44 Activated carbon air filter unit for wash plant air
45 Activated carbon air filter prior to discharge
46 Air discharge stack

storage pond[5] at the far west end of the site. Sludge from the water treatment units may be added to the deep cone sludge thickener.

Contaminated slurry from the wash plant is fed into two large holding tanks[25] at the front end of the metals chelation process. Each tank can hold about two day's supply of contaminated slurry produced by the wash plant. The contaminated slurry will be about 30% solids by weight, 70% process water. A mild acid is pumped from one of several acid storage tanks[26] and is added to the slurry in the holding tanks, to solubilize any metal contaminants and desorb these from the soil particles.

The contaminated slurry is pumped from the holding tanks[25] into the first tubular reactor[27]. This is a screw type reactor, and inside this reactor, the contaminated slurry comes into contact with the metals chelating agents which have an affinity for attracting specific metal contaminants. Parameters like the chelating agents or the amount of contact time between the chelating agents and the contaminated slurry can be varied, to remove only those metals or inorganics that are considered to be contaminants, and to only remove the amount of those contaminants necessary to have the soil considered as "clean".

The slurry that now contains only soil particles, organic contaminants and process water, is discharged by pump to a holding tank[28] where it is mixed with an oxidant before passing to the biological treatment system.

The chelating agent with the contaminant inorganics (metals) is then fed through a second tubular reactor[29] where a mild acid is used to break the bond between the chelating agent and the contaminant metals. The chelating agent is then recycled to the first reactor[27] for reuse. The metals/acid mixture is pumped to an electrowinning unit[30] where the metals are removed on plates by electrolysis, and the acid is returned to the holding tanks for reuse.

Alternatively, some metals such as lead may be precipitated from the metals/acid mixture in a separate tank and any spent acid solution either reused or neutralized and discharged to the holding tank[25] and added to the contaminated slurry.

Metals removed from the electrowinning unit[30] are removed in pure metal form where they are no longer a contaminant and are a valuable raw product for some metals refining industry. They can be removed as one mass containing all metals, or selectively as individual metals.

Following conditioning or oxidation, the contaminated slurry is pumped from the holding tank[28] into the two surge tanks[31] at the front end of the biological treatment process. The slurry is stored in these two tanks and is gently mixed to prevent any particles from settling.
Slurry containing organic contaminants is fed from the surge tanks[31] into three (20,000 gallons each) upflow bioreactor tanks[32], where bacteria are fed air and, if necessary, co-nutrients from storage tanks[33] to maintain an optimum bacterial activity to digest contaminant organics in as short a time as possible. Constant mixing and suspension of fines is provided by submerged pumps and upflow of air.

When the bacteria have reduced the organics content in the slurry to below MOE guideline levels for industrial soils, the slurry is pumped to the sixth tank[34] in the biological treatment system, an aerobic digester where endogenous respiration occurs. That is, the food supply is cut off and the bacteria digest themselves. This condition is allowed to continue until the measured oil and grease (including biomass) level in the slurry meets MOE guidelines for industrial soils.

The decontaminated slurry is then pumped from the endogenous respiration tank[34] to a holding tank[35] before it passes through three hydrocyclones[36] where it is partially dewatered. The partially dewatered fines are collected in a holding bin[37], are now clean, and can be combined with the clean soil from the wash plant[17 23] for reuse as clean backfill at the excavation site.

Water from the hydrocyclones[36] passes through flocculation and sedimentation tanks[38] to a mobile water treatment unit[19], where it is treated to process make-up water requirements and discharged to the water storage cell[5] for reuse as process make-up water.

Air for the bioslurry reactors is taken in through two intake units[40], filtered, and pumped through a 6 inch diameter header to the bioslurry reactors. Air is fed into the bottom of the reactors and discharged from the top into an air collection system whose ducts run along the north side of the building to two biofilters[41]. Two pumps[42] with 5000 cfm capacity each draw the air from the bioslurry reactors and force it through the biofilters.

Air collected from the metals chelation process is passed through a wet scrubber unit[43] to remove any acid before it, too, is drawn into the air ducts and fed into the biofilters[41]. Acid removed from the scrubber is either recycled for reuse or is neutralized and discharged to the holding tank[28] for addition to the slurry.

Air collected from the attrition scrubbing wash unit first passes through an activated carbon filter[44] and is then drawn through the two 5000 cfm pumps[42] and is forced through the biofilters[41].

The biofilters[41] are two 40 ft. long units, 8 ft. high by 8 ft. wide, with perforated air supply pipes laid on the bottom covered by peat. Air is pumped through the supply pipes and filters through the peat. The units are air tight, so that air filters through the peat and is collected and discharged to another activated carbon filter[45] where it is further polished before being discharged through a 40 ft. high stack[46].

Air quality monitoring inside the process building and around the site will continue throughout the demonstration programme.

Treatment Of Soil Sample Washed In Holland

Our demonstration is actually a test to compare the effectiveness of two soil washing processes, followed by metals removal by chelation and organic contaminants reduction by biological activity. We were able to lease a 5-10 tonnes per hour attrition scrubbing soil washing plant from Bergmann USA out of Stafford Springs, Connecticut, for about four months, to wash about 3000 tonnes of contaminated soil (1000 tonnes of each of three samples) on-site. To test the effectiveness of the high pressure soil washing technology we shipped 1050 tonnes (350 tonnes of each of three samples) of contaminated soil to a commercial wash plant in Weert, Netherlands, operated by BSN Bodemsanering Nederland. The soil was shipped in lined burlap bags containing about one tonne of soil in each bag. The bags were loaded into 20 tonnes containers for easy handling and shipping.

BSN washed our soil and returned all of the cleaned soil and contaminated slurry to us. The cleaned soil was returned in the same lined bags, and shipped again in containers. The contaminated slurry was returned in lined 45 gallon drums, also stowed in containers. The drums were emptied into a holding tank, where the contaminated slurry was then pumped to the two holding tanks[25] at the front end of the inorganics removal process, for further processing to remove inorganic and organic contaminants.

Project Funding

Total cost of this Soil Recycling Demonstration Project is approximately $7.0 million and is funded $5.0 million by The Toronto Harbour Commissioners and $2.0 million by SNC Inc. All of the funds are private funds, that is, no tax revenues or public funds have been invested in this demonstration. The THC receives no tax monies or public funds, obtaining its revenues from Port operations fees, engineering fees and lease of its lands. SNC Inc. is a Canadian company with its shares listed on the Toronto and Montreal stock exchanges.

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PROVINCIAL 3R'S POLICY

by

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At the time of assembly of the Proceedings for printing, a text of the author's paper had not been submitted for inclusion in the numerical sequence.

If the paper was subsequently received, it is incorporated in these Proceedings following the listing of the Conference delegates.

Otherwise, those wishing further details on this subject, are asked to contact the author direct.

9/22/92

METROPOLITAN TORONTO WET WASTE COMPOSTING PILOT PROJECT

Andrew Pollock - Manager, Waste Reduction
Metropolitan Toronto Works Department

Introduction

- The pilot project started in November 1991 and will run until December 1992.
- The objectives of the pilot are to evaluate household participation levels and end product quality before full scale implementation of food waste composting.
- Organic kitchen and yard waste will be collected from 15,000 single family households in Toronto, North York and Etobicoke.

Household Containers

- All participating households are being provided with a household container system for food waste.
- All container systems include plastic bags for inhome collection. Some homes will be provided bags while others will be expected to provide their own.
- Some homes will get under the sink receptacles for holding bags and most homes will get a rigid container for outside storage.
- We will evaluate impact of different container systems on participation and recovery levels.
- The impact of backyard composters on participation and recovery levels will also be evaluated.

Composting Operation

- Bagged material is collected weekly in packer trucks and delivered to the Dufferin Transfer Station.
- The primary composting operation is a Fairfield Digester from the old Ontario Resource Recovery Plant at Dufferin.
- Modifications have been made to enable the digester to accept source separated organics.
- Collected organic material is tipped on an enclosed receiving floor.
- Brush is removed from incoming material and chipped for use as structural material throughout the year.
- Material is loaded into feed hopper and conveyed to a bag breaker - two parallel augers that carry material through two round openings with protruding spikes to tear bags open.
- Organics and torn bags are then conveyed to a trommel screen.

- Oversized (over 5") material and bags pass through the trommel and are conveyed to a trash compactor.
- The undersized (under 5") compostable fraction falls through the trommel and is conveyed past a magnetic separator to the digester.
- The digester is large concrete vat - 56' in diameter and 8' high - with a rotating steel cover that supports 13 mixing augers.
- Material is conveyed to the centre of digester cover then conveyed to outer edge of the cover and fed into digester.
- The rotating augers inside the digester mix the material and slowly move it to centre.
- Air is forced up through the material from perforated pipes embedded in the gravel floor of the digester.
- When material reaches a height of 68" it flows out the exit chute in the centre of the digester and is conveyed to an outside storage bunker.
- The material is then loaded by front end loader into the secondary compost operation which consists of four aerated curing cells.
- Exhausted air from digester is piped underneath the curing cells. This aerates the static piles and filters odours out of the air from digester.
- After eight weeks the material is screened to produce a final product.
- The finished compost will be sent to the University of Guelph for testing.
- Plant Capacity - 50 Tonnes/Day Input
- 25 Tonnes/Day Output

Conclusions

- Weekly household participation levels are averaging about 35% per week, but it is too early to evaluate project effectiveness.
- Metro is initiating a comprehensive survey of participant attitudes and behaviour to evaluate the collection component of the project.
- Centralized composting is seen as a possible solution for organic kitchen waste from households that cannot use or choose not to use backyard composters.
- For large generators of industrial/commercial food waste it may be more appropriate to convert the waste into high quality liquid animal feed.

Blue Box 2000

Robert Argue, Recycling Coordinator
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In November, 1991, the Centre & South Hastings Waste Management Board, with support from Environment Ontario, launched **Blue Box 2000**. Blue Box 2000 is a systems approach to waste diversion and involves 5 main areas of activity:

◊ Maximizing diversion through an expanded Blue Box program.

◊ An Office of Waste Reduction.

◊ An aggressive Backyard Composting program.

◊ A Household Hazardous Waste program.

◊ Integrated IC&I sector diversion activities.

The premise of Blue Box 2000 is that a conventional source-separation curbside Blue Box program can be pushed to achieve maximum diversion of clean, marketable materials using existing or modified facilities and systems that are currently available to the municipality. The system will also involve the public in waste reduction and diversion, and should be economical. The goal is a diversion budget that is less than the disposal budget.

Diversion Goals

The expanded and deepened Blue Box program should divert about 30% of the household stream. Backyard composting will divert a further 21%, while the local reduction goal is 3%. This combination of approaches would achieve a total of a 54% diversion of the household waste stream.

Meeting this goal will provide other communities with a model of a cost-effective and efficient way of achieving or exceeding provincial guidelines.

Centre & South Hastings

Centre & South Hastings consists of 15 municipalities in Eastern Ontario. It has a population base of 95,000. The recycling facility, located in Trenton, serves many other municipalities to the south (Prince Edward County), east, and north. In all, the facility serves a total population of 130,000.

Blue Box Collection

There are 3 approaches to expanding the Blue Box program:

- ◊ Increase the **participation rate** from its current level and involve all sectors. This includes all householders, apartments, schools, institutions, and businesses.
- ◊ Deepen the **capture rate** of currently-collected materials.
- ◊ Broaden the **types of materials** collected in the Blue Box to include rigid plastics, foam plastics, film plastics, boxboard and mixed household paper, magazines, OCC, textiles, aluminum trays and foil.

The Centre & South Hastings Blue Box 2000 collection includes a total of 38,500 boxes:

21,000	urban curbside
3,200	apartments
9,100	rural curbside
4,200	rural depots
1,000	IC&I curbside

The New Materials

The program collects:

newspapers	cans
glass	rigid plastic
OCC	boxboard
household paper	magazines & catalogues
film plastic (LDPE)	foam & rigid PS
textiles	aluminum trays and foil

The public is asked to setout the material in 6 groupings. The material is separated into 7 compartments curbside, and further sorted to 20 resource streams at the recycling facility.

Blue Box 2000 Impact

The program was designed in 1989/90 as a conventional program. It became the Blue Box Plus demonstration program at its launch in the fall of 1990. Boxboard, rigid plastic, and OCC were added at that time. **Blue Box 2000** was started in November 1991. The following chart compares the needs of the various programs.

Blue Box System Requirements

	Blue Box	Blue Box +	Blue Box 2000
# of trucks	6	8	10+
# of materials	5	12	20+
capacity (tons/day)	20	35	50+
processing space		for extra materials	
storage space		for extra materials	

Results

Not all programs have been implemented and data collection is ongoing. Preliminary results indicate the public is responding well to the greater level of effort required. Average curbside collection in Belleville/Trenton/Sidney is running at 450 lbs/hhld/year. Recycled tonnage figures have increased dramatically, and waste diversion is currently running at 35% compared to 1989.

The following chart looks at monthly costs averaged over Jan. – Apr. comparing 1991 and 1992. Costs are net of revenue but before any subsidy, and are for contractor charges for collection, processing, marketing, administration, and hotline. Costs include maintenance and maintenance reserve, but do not include any capital or depreciation or municipal administration costs. Processing charges and revenue from other municipalities and IC&I material that is dropped at the facility have been backed out. If IC&I tonnage, including processing charges and revenue, was included, the municipal costs would be lowered by about $10 per ton.

Average Program Operating Costs

	1991	1992	% increase
tons/month	393	578	47%
# of households	33,500	38,566	15%
net cost per month	$59,578	$76,683	29%
$/ton	$158	$133	-13%
$/hhld/yr	$21.34	$23.86	12%

Waste Reduction

There are a number of local landfill sites servicing the area that do not weigh material coming in. Their measurement is based on volume and they are reporting a 30% to 50% reduction in volume. Some municipalities have reported that they are considering introducing bi-weekly garbage pick-up this fall due to reduced volumes.

The 3 largest municipalities in the region have weigh-scale data — some going back to 1989 before recycling or backyard composting. The first 4 months of 1992 is showing a 35% reduction compared to 1989.

year	% reduction
1989	base
1990	5%
1991	27%
1992 (4 months)	35%

Sidney Diversion

Based on weekly scaled data for disposal and recycling, with an estimate based on the known backyard composters distribution (~22% of hhlds.), the following chart summarizes current diversion levels and compares them with the target.

	current	target (by the end '92)
recycle	26%	30%
compost	7%	21%
reduction	2%	3%
total	35%	54%

Still to Come

Blue Box 2000 is a continuing program, with new components being introduced and ongoing monitoring and analysis. Starting in mid-June, there is a door-to-door distribution of free backyard composters. There is also a new education and promotion program. Some of this will be area-wide through newsletters and media, while other promotion will be through pilot door-to-door education.

There will be further information generated through:

◊ collection and sorting analysis

◊ material sort analysis of different material streams

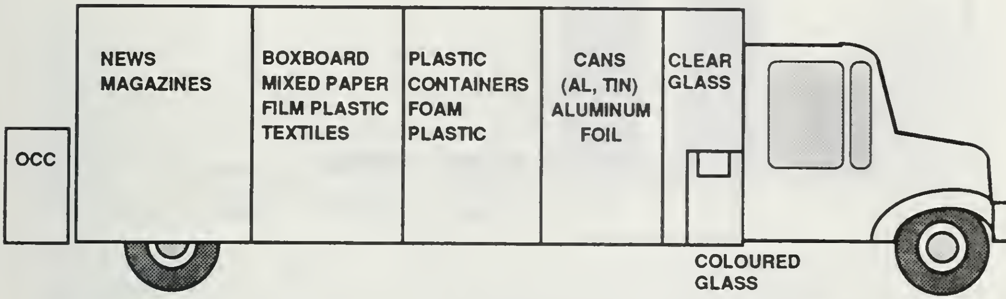
◊ surveys/education

◊ market development

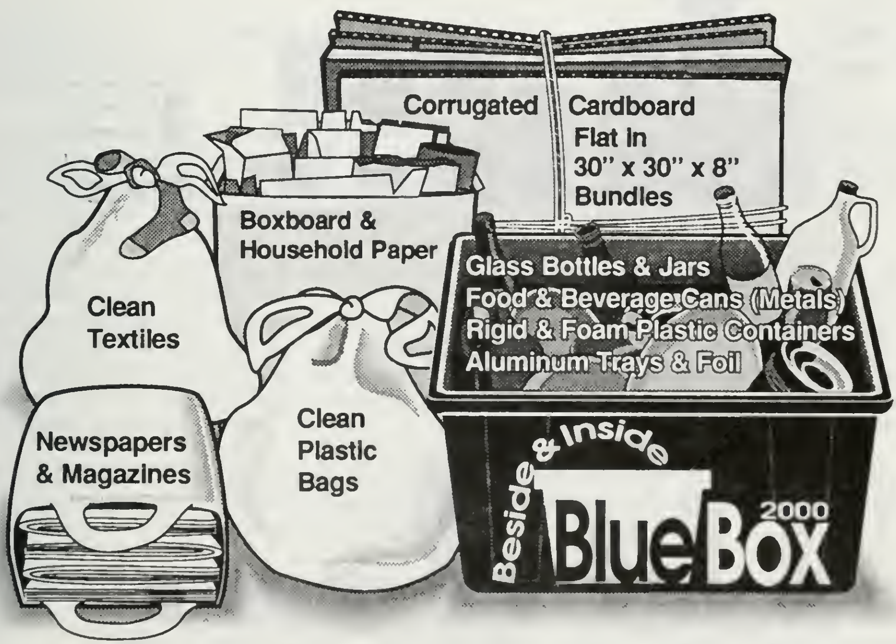
◊ participation surveys

◊ waste composition studies

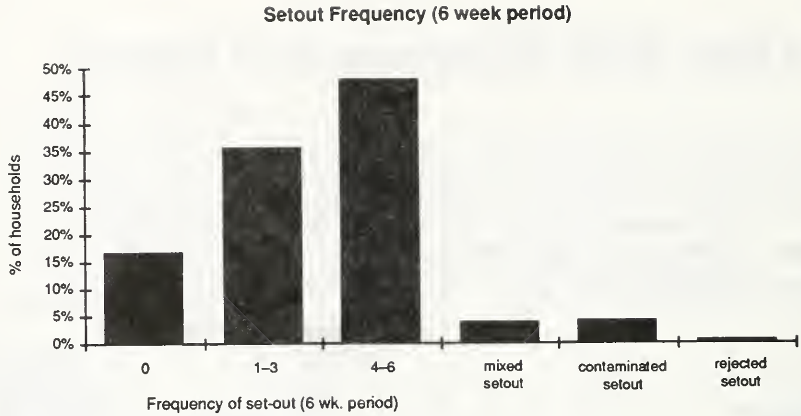
Blue Box 2000 Materials and Setout

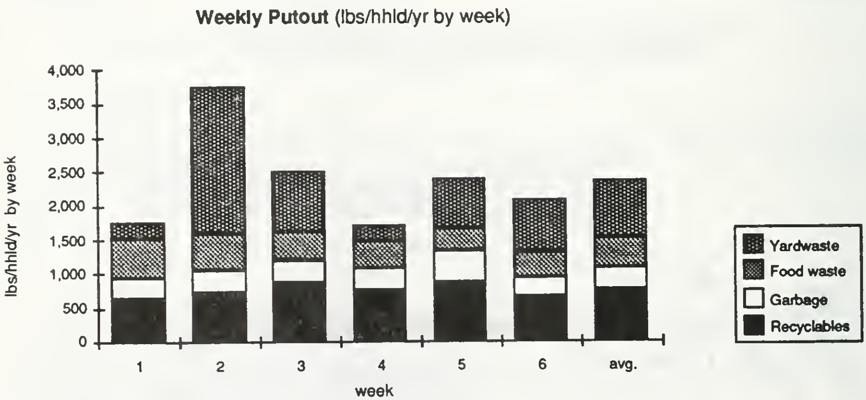


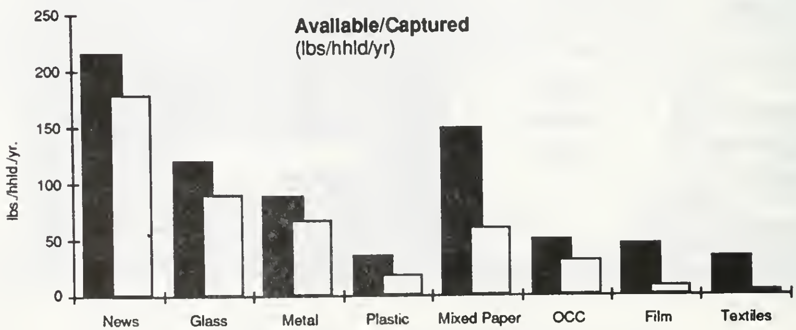
Truck Compartments



Householder Setout







The upper chart — **Setout Frequency** — is based on 1200 hhlds checked over 6 weeks. Mixed setouts were not set out to Blue Box 2000 specifications. Contaminated Setouts included material not acceptable. Rejected Setouts were unacceptable because of high levels of garbage or a total mix of material.
The **Weekly Putout** examines the weekly composition for 50 hhlds. extrapolated over the year. The average is 2177 lbs — 34% recyclables, 52% organics, 14% other waste. Numbers have not been adjusted for time of year, and do not include C&D or bulk waste.
The **Available/Captured** chart is based on 50 hhlds (including non-participants) for 6 weeks and compares recyclable catagories available in the waste stream vs captured by the Blue Box. Available recyclables totals 746 lbs/hhld/yr. 62% were captured.

PLASTICS AND THE CONSERVOR SOCIETY - AN INTEGRAL PIECE IN THE JIGSAW PUZZLE?

by
F.H. Edgecombe, Executive Director, Environment and Plastics Institute of Canada, Mississauga, Ontario

During the period when the Ministry of the Environment was developing the term "The Conservor Society" I was privileged to participate in one of the focus groups which examined a number of potential phrases. My group did not rate "Conservor Society" as number one however the discussion around it was animated and broad in scope. I do not believe that I have ever seen an official definition of the term but a short while ago I did investigate the meaning of the transitive verb "conserve". The Oxford Dictionary defines it as; "keep from harm, decay or loss especially with a view to later use; maintain quantity of something constant". One of the fundamental laws of physics is the Conservation of Energy. Energy is neither created nor destroyed but rather transformed.

I would like us to keep this definition in mind this morning. Keeping something from harm, decay or loss especially with a view to later use when looked at objectively and systematically carries us well beyond the notion of raising the drawbridge at the landfill gate. A systematic perspective causes us to ask a variety of questions which leads us to that realm of speculation about why the article existed in the first place. The use of such a perspective is not an idle philosophical method the outcome of which is "it exists therefore it is" but rather it enables us to move beyond the borders of our preconceived notions to assess true value of a product.

The previous speaker discussed the Blue Box 2000 Programme and the next speaker will talk about markets for recycled materials. It was and will be very obvious that much of their talks dealt with packaging materials.

At the present time you, I and most of society view packaging in the way a drunk views an empty bottle, a source of irritation and something which must be disposed. Like the drunk, we very quickly forget that the container was an integral part of the system which enabled us to partake. When it is empty it doesn't much matter to us whether the container was a stone jug, a glass bottle or a metal can.

Our society sees packaging as an empty, a discard. A true conservor society would have a better understanding of packaging, relate it to the definition of the verb "conserve" and acknowledge the connection between the package, its contents and our ability to receive the contents in good condition. Once we have adopted this broader view we can make rational choices and create systems which provide the maximum level of conservation consistent with our need for the product. Once we have a systematic approach we will see more clearly how some of our habits and lifestyle concerns impact upon the husbanding of Earth's resources.

China loses 50% of its agricultural production to vermin and spoilage because it lacks adequate packaging to deliver the goods to its people. Do those who cry "eliminate packaging" acknowledge the potential waste falling out of a literal following of their tenet?.

Probably very few people in this room have lived in a society where fresh meat and produce was not available every day in whatever quantities they desired. Partially by virtue of my advanced age and partially by virtue of geography, I can remember growing up in (what is now) a part of Canada where fresh meat was available on Saturday and the produce available in the winter was literally the root vegetables which could be stored over the season. No one starved and many appetizing dishes can be made from salt beef, pork and dried fish but not too many Newfoundlanders would be willing today to give up Sobey's supermarkets and revert to the lifestyle of their fathers and grandfathers. It is packaging which has enabled the change to happen.

Later in my life I lived for a number of years overseas. On my short walk from the lab to my digs I passed by a butcher, several bake shops, a wine merchant and a green grocer. The fact that I had a minuscule refrigerator didn't bother me. I could easily shop every day. Walk from 1st Canadian Place to Union Station and tell me how many small shops you pass; walk from the GO station in Port Credit and tell me how far you have to go to find a grocery store. We as a nation are different from the English and Europeans in local infrastructure and as a result we have adopted once a week shopping which by and large depends on a sophisticated system of packaging.

I have taken you through this somewhat philosophical exercise because I am now going to talk about plastics and I want you positioned on the mountain looking over the landscape rather than fighting dragons and other mythology in the moat around the landfill.

There are many in our society who would say that plastics are symbolic of a wasteful society. Every day the mythology is trotted out.

- Plastics consume large quantities of unrenewable resources; paper comes from renewable resources. Have you tried to pull a roll of toilet paper from a spruce tree lately? How do trees become paper? By a process consuming large quantities of energy.

- Plastics are not biodegradable therefore they are bad. What happens biologically in a landfill; little if anything, even to carrots.

The myths go on and on but over time, from a higher viewing point, we will see the fog lift and the true landscape appear.

What are the realities? Let's explore them under the R's. Before we commence, a word of caution. Our society seems to have created a hierarchy of R's. Reduce, Reuse and Recycle naming but the first 3 in the list. This hierarchy has been created from the perspective of the guard tower at the landfill and it has been our wont to separate the R's into individual nonconnecting chambers of the guard tower.

From a different vantage point, Mount Conservation, a more realistic assessment of the value and relative position of R's apropos a particular action or product is possible.

Reduce

Reduction at source is promoted as a primary "R". Garbage in Garbage out; reduce the amount going in you'll get less out. This is the base from which the packaging nihilists operate. Eliminate the package. We have already touched on this and recognized the caveat that eliminating the package can create waste of another sort.

Plastics have made substantial inroads on other materials by virtue of their ability to affect a reduction in the quantity of material needed to get a product to market. Reducing the amount of material results in savings and efficiencies all through the distribution chain. These savings can accrue from:

1) less spoilage by virtue of the barrier properties of materials or faster delivery, by air for example, because one is delivering more weight of product and less weight of packaging
2) lower energy consumed in delivery.

All factors to be considered by a conservor society.

For years our industry has continued to reduce the material weight of its packages. The PET soft drink bottle of today uses much less material than the base capped clunker of a few years ago. But a two litre bottle still looks like a two litre bottle when it is empty and unless we enrol our little grey cells to carry out a benefits analysis we won't appreciate what has been done.

The plastics industry will continue to source reduce its products, it makes good economic sense to do so. I believe that our industry (by virtue of its ability to synthesize and organize molecules to produce products meeting specific needs) has more scope for reduction than any other material industry. A true conservor society would look seriously at fostering and promoting these attributes.

Reuse

Reuse in our thinking of late has taken on a special connotation. It has become "refill" and the emphasis seems, at least to me, to be directed at beverage systems.

There is a multitude of examples of reuse generally in the industrial commercial area to which the public is rarely exposed. In many of these plastics play an integral part.

Consider how bread is delivered to supermarkets. (knock down plastic trays) -- how auto parts arrive just in time in reusable plastic totes, how fish are transferred from ship to packer in plastic boxes. The plastic 45 gallon drum is cat's lives ahead of steel drums in their ability to be reused. What about the bottle on the water cooler in the home or office and the returnable refillable insecticide tank on the farm?

Think about other examples you are aware of and note how many of them involve plastics. There is a myriad of applications where plastics are reused but unfortunately once again our perspective is myopic and we see nothing but soft drink containers.

Even with a narrow focus we do not see clearly. We get caught up in a process, the act of refilling containers and fail to adopt the conservor point of view which will study the system. How many return trips does a refillable glass bottle with a contents-to-package weight ratio of 1.04:1 have to make before it is more energy efficient then a PET bottle with a contents-to-package ratio of 38:1 particularly when last year almost 70% of the 2 L PET soft drink bottles manufactured in Ontario were collected in the Blue Box programme. All of these containers were used in bonafide, "high value in use" applications such as the manufacture of fibrefill.

There are many applications particularly in the packaging of food where plastics should not be reused. It is not that they cannot be reused in a technical sense but rather a health consideration which has nothing to do with the polymer but with how the consumer has used the container after its contents have been consumed. Insecticide for example, stored in a plastic bottle, could be absorbed into the walls (depends on the insecticide). This is very difficult to remove in some instances and even a few contaminated containers pose too great a public liability.

Recycling

If you dig through the landfills of Ontario you are not going to find large quantities of plastic pellets. Even an attack on the landfills of Lambton County (the Sarnia area being the site of many resin plants) will not turn up basic resin. It is not that the industry does not make off-standard resins from time to time, but rather a substantial infrastructure exists to handle off-standard materials.

Go into any large film plant or bottle blowing plant and you will not find large quantities of edge trims or handle trim being carted off to the dump. The trim and reject bottles etc. all find their way back into the hopper of the extruder.

For those companies who do not or cannot reprocess their plant scrap there are numerous companies for their so-called waste materials.

Those who say that plastic cannot be recycled neglect to consider this aspect of the industry. Once again we have set up our telescope on the ramparts of the landfill and have directed it at the plastic component of post consumer packaging.

I would be less than candid with you if I did not tell you that for a long time the plastic industry believed that it could rely on rational evaluations of its products which show them as beneficial in terms of energy conservation, performance and so on.

However, over the last several years the industry has awakened to the fact that in many matters the publics' perception is the publics' reality. McDonald's Restaurants came to the same realization not so long ago. If the public doesn't like the way you present your food you had better change. Unfortunately, action based on public perception is not necessarily the best especially in environmental matters but standing alone unsupported by government or even knowledgeable segments of the population, is not conducive to good health.

Plastics are different from other materials when it comes to reprocessing. A steel container can be dropped into the electric arc furnace and incorporated into the batch of steel. Similarly a flint glass bottle can go back into the glass furnace. To take a polyethylene bottle and put it back into a polyethylene resin plant requires an interface which is essentially an oil refinery. You can pyrolyse a polyethylene bottle and drive it back to gaseous products but then you have to refine or reform that gas to get ethylene. As result, our industry has to operate in a different manner and is often attacked because it doesn't practice what is known as closed loop recycling. I'm not sure that closed loop recycling is all that important. If I can displace the use of virgin material in a car part with reprocessed resin is that not a valid application?

Some types of plastics can be more easily cracked back to their chemicals than polyethylene. PET is such an example and plants are being established to take post consumer PET and through a process of methanolysis take it back to terephthalic acid and polyethylene glycol. One then repolymerizes these chemicals to produce pure PET.

The manufacture of plastic resins is carried out in huge plants. The capacity of a typical polyethylene plant is 500 million pounds per year.

Even a reprocessing plant must be of substantial size in order to justify the capital equipment necessary to operate at reasonable cost.

A plant of a capacity of 30-40 million lbs per year has a chance.

One of the reasons for the slow start in reprocessing was a concern for raw material. You cannot build a plant with 30 million lbs of capacity and operate it at one million lbs per year. You can't do it physically and you can't do it economically.

Which comes first, the plant or the source of raw material? Can they both proceed in parallel development?

In reality plants appeared in Ontario before Ontario based feedstock. Ontario now has world class facilities for handling polyolefin products and polystyrene products. Since post consumer collection has not developed to the necessary degree, these plants operate on a mix of industrial and post consumer material and in some instances with imports of specific feedstocks (eg. milk jugs from the U.S.)

Compounding the situation has been the recession which has literally knocked the bottom out of basic virgin resin prices. World overcapacity for commodity resins has depressed prices to mid-1970's levels and the prices of virgin resin impinge directly on what will be paid for reprocessed material.

One other factor which has a significant effect on the reprocessing of post consumer plastic materials is the diversity of resin types in the various applications.

Many applications are resin specific. You package soft drinks in PET. You can't package them in polyethylene because polyethylene is transparent to CO_2 and the pop would lose its fizz in a few hours. You can't package dish washing liquids in the polyethylene used for margarine tubs. You do package liquid detergents in polyethylene but a resin which is formulated to provide resistance to detergent stress cracking. This resin is not suitable for the production of the thin-walled margarine container.
As a result, the containers collected in a Blue Box programme are of different resin types.

Although in a bottle stream 90% of the materials are HDPE and PET, you can't process PET if it is contaminated with any PVC. As a result, to obtain maximum value for the materials they must be sorted.

Some municipalities do do some sorting. They obtain economic benefit from doing so. However they are left with a small mixed residue with a home only at a processor of commingled material making lumber etc. Some municipalities don't want to sort and consequently have limited opportunities to dispose of their products.

The plastic industry is addressing these issues.

We have recently issued a guide for establishing a plastics recycling programme.

With the assistance of the MOE we will shortly be able to provide to municipalities a computer model to cost Blue Box collection. This will be an aid in seeking means to operate the collection system more effectively.

We have also demonstrated a procedure to collect at curbside plastic film. Following this method, a clean stream of material can be obtained which is admirably suited for reprocessing. Peterborough is using this procedure citywide.

Of particular note is the fact that a consortium of the plastics industry is being formed to establish a sorting facility in Ontario.

This facility will take bales of plastic containers from municipalities and sort them into generic resin streams all of which can be reprocessed.

This proposal is now at the stage where negotiations with an operator are in process, the technology has been defined and agreements to legally form the consortium are being reviewed by corporate lawyers. The products flowing from such a sorting facility have been spoken for.

Once this facility is in place the industry will need an ongoing supply of feedstock and we shall be pressing to have all Blue Boxes in Ontario take a range of plastics in addition to the soft drink container.

The concept of a "conservor society" is very sound and an integral part of broader programmes of sustainable development. It is not, however, a concept which can be attached to a moving garbage truck and we must be careful that we don't place it there. In a conservor society many traditional positions must be challenged in an honest and straight-forward manner. If we are willing to allow some old positions to fall and new ones to arise, we can make our society a better place to live and plastics will be there contributing to better things for better living.

MARKETS FOR RECYCLED MATERIALS

by

Geoff Rathbone, Regional Recycling Manager,
Laidlaw Inc., Burlington, Ontario

DEFINITION OF QUALITY

- General Principles of Buyer/Seller Relationship
  - Seller will use due diligence to assume shipment is properly packed and on time.
  - Buyer will not arbitrarily cancel, reject or downgrade shipment.

- Grade Definitions
  - Prior to shipment both parties must clearly understand what the seller will ship and what the buyer can use.
  - Primarily defined by:
    - description of what is desired.
    - quantitative limit on out-throws
      - can make grade unsuitable
    - quantitative limit on prohibitives
      - can make grade unusable
  - Other important considerations
    - tare
    - loading equipment
    - moisture content
    - age

VALUE ADDED CHAIN - REVERSE ENTROPY

In-house Separation
and Collection

0 —————— 40

Collection and
Tipping
40 —————— 60

Materials Processing
60 —————— 80

Benefication and
End Usage
80 —————— 100

DESIGNING FOR QUALITY - IN-HOUSE ISSUES

Audit/Waste Characterization Study

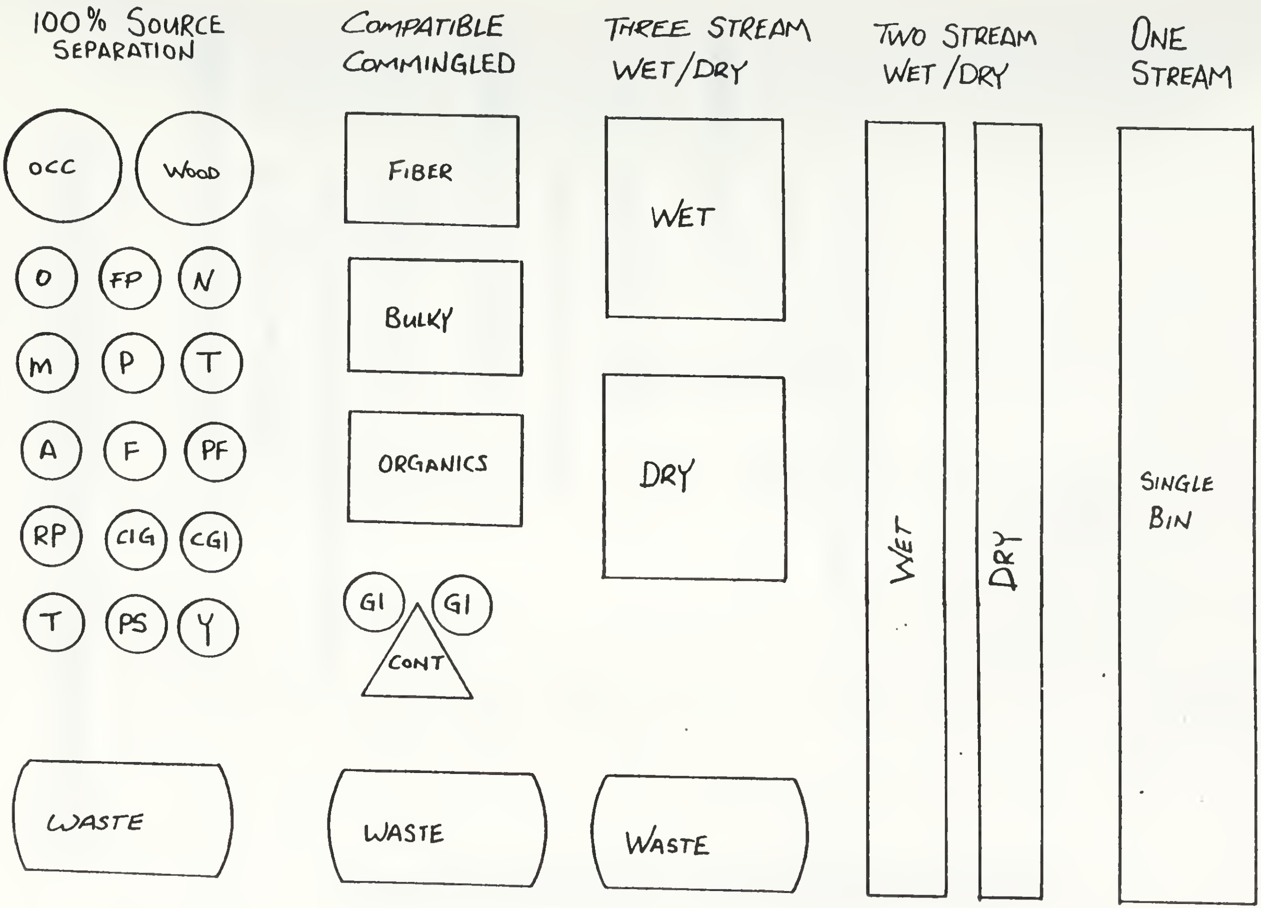
- o By weight quantification
- o By Composition/By Point of Generation
- o Purchase for 3R's

Controlled Source Separation

- o Must match later systems
- o Manageable # sorts

In-House Collection

- o Keep separate
- o Accumulate for external collection


100% SOURCE SEPARATION
OCC
WOOD
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PS
Y
WASTE
COMPATIBLE COMMINGLED
FIBER
BULKY
ORGANICS
GI
GI
CONT
WASTE
THREE STREAM WET/DRY
WET
DRY
WASTE
TWO STREAM WET/DRY
WET
DRY
ONE STREAM
SINGLE BIN

MATERIALS PROCESSING

Primary Functions

- Tipping Floor
- Prohibitive Contaminant Removal
- Co-mingle Recyclable Separation
- Densification
- Unit Load Accumulation

FINDING A MARKET

Domestic

- o Local niche users (i.e. animal bedding)
  - lower freight
  - more mutually dependent
  - can be seasonal
  - revenue often exceeds market
- o Regional Mills
  - one of many suppliers
  - large consumption
  - market price

Export

- o For benefication
  - undergo further sorting
- o Direct to Mill
  - usually through broker
  - one to six month orders
  - container weight critical
  - delayed feedback

NEWSPAPER

Market Conditions

- Steady to strengthening domestic demand
- New capacity at Atlantic, CPFP Thunder By, CPFP Gatineau, Daishowa Quebec City
- Many new sources as U.S. recycling matures

Key Constraints

- Quality assurance as commingling increases
- Demand for finished recycled content news

MAGAZINES

Market Conditions

- New de-inking capacity based on flotation technology
- Require up to 30% coated ground wood
- Good demand

Key Constraints

- Recovery rates for magazines
- UV inks

PHONE BOOKS

Market Conditions

- Steady to weak demand at Regional/export mills
- Good local demand in some areas for animal bedding - No densification

Key Constraints

- Low pricing

GLASS

Market Conditions

- Steady demand for colour separated containers
- Some shipping delays

Key Constraints

- Mixed colour glass
- Potential need for three colour separation
- Weaker demand for coloured grades
- Inability to commingle

CANS

Market Conditions

- Demand steady for both ferrous and aluminum
- Price and percent content of aluminum drastically depressed
- Increasing ICI collection

Key Constraints

- Unable to cost effectively separate aluminum

<u>**OCC**</u>

Market Conditions

- Prices very depressed
- Domestic supply exceeds domestic demand
- Exporting to accommodate excess
- Medium term future loads positive as numerous mill expansion/conversions underway

Key Constraints

- Wax OCC
- Asian content
- New grade definitions as blue box material becomes common

FINE PAPER

Market Conditions

- Technology advances are allowing broader paper mixes
- Collecting from more small/medium generators
- Steady demand as mill expansions/start-ups meet increased supply
- North American market

Key Constraints

- Closing the loop

PLASTICS

Market Conditions

- Steady demand for "high graded" select materials
- Poor to no demand for other grades
- Export market very volatile
- Shift of end market to demand supplier ownership through benefication

Key Constraints

- Complexity of feedstock
- Low weight/volume ratio

TEXTILES

Market Conditions

- Shift from drop off depot to curbside collection
- Higher quality, more reuse, more convenient
- Collect all household textiles in Mississauga
- Co-operate with non-profit organizations

Key Constraints

- Wet materials
- Newspaper contaminant

WOOD

Market Conditions

- Fibre usage
  - landscapes
  - compost
  - chipboard
  - papermill

- BTU Content
  - steam plants
  - electrical generations

- Price dependent on quality and degree of benefication

Key Constraints

- Pressure and creosote treated woods

- Shipping weights

- High tipping fees retard implementation in low tip fee regions

DRYWALL

Market Conditions

- Demand exceeds supply
- Pay tipping fee of $65-75 tonne loose
- Available quantities may have been overstated

Key Constraints

- Tipping fee exceeds disposal fee in many areas

FOOD/LANDSCAPE WASTE

Market Conditions

- Options
  - Pig farmers
  - Compost
  - Renders
  - Animal feed converters
- $0-80 per tonne tipping fee charge

Key Constraints

- Age of material
- Protein/bone content
- Contaminants plastics/paper
- Collection techniques

FUTURE TRENDS

Materials

- Durable Goods
- Organics
- Expanded Fibre Collection
- Composite Materials
- Plastics

Markets

- Prices steady to lower, will pay at many markets
- Increasing quality demands
- Further grade definition
- North American/Global Access

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